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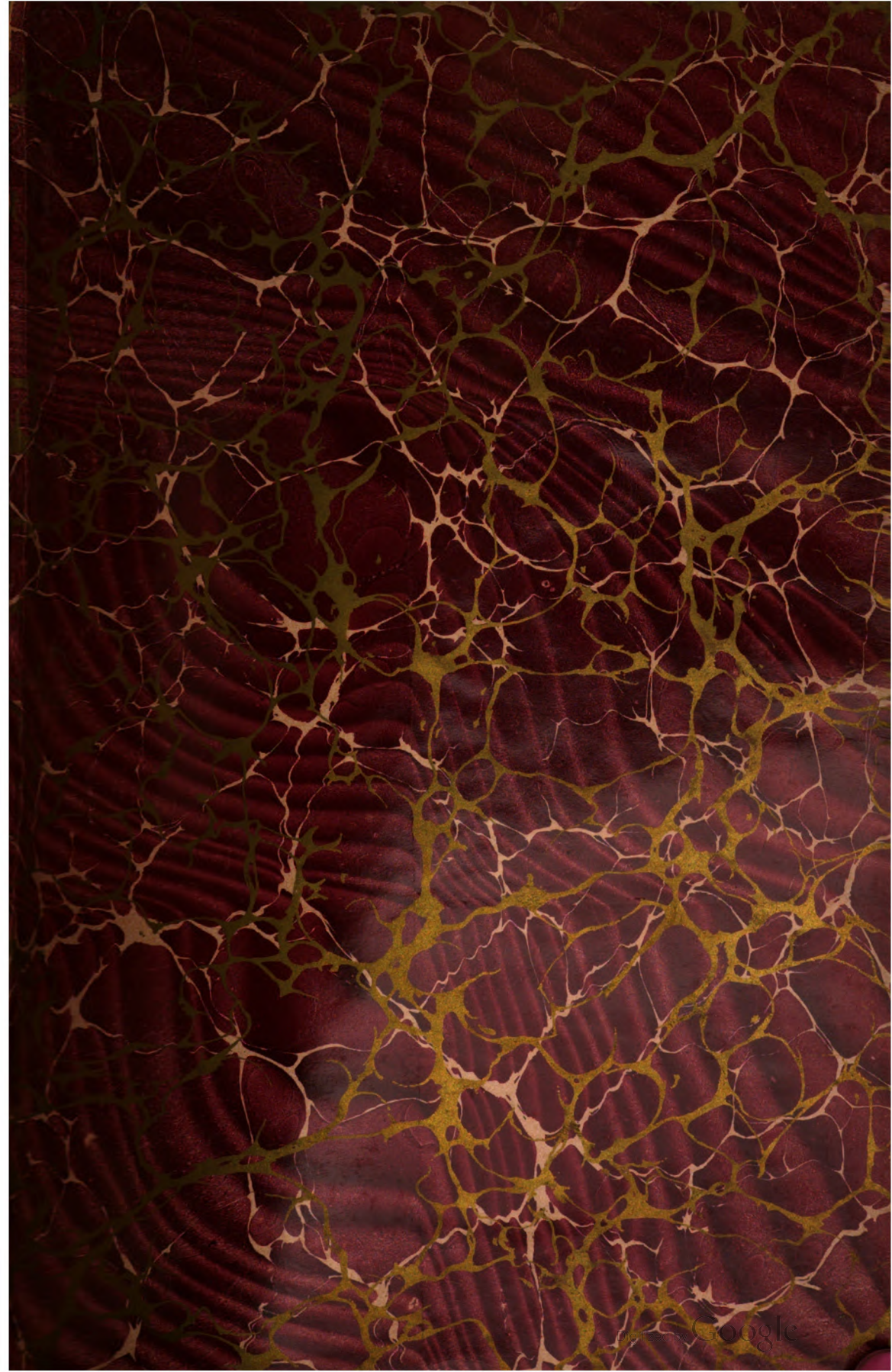
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GIFT OF

Dr. J. J. Rothrock
Commissioner of Forestry



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(Plate 5. See pages 45 and 325.)
Falls near Bushkill, Pike County.

ANNUAL REPORT

OF THE

PENNSYLVANIA

Department of Agriculture



For 1895.

PART II.

DIVISION OF FORESTRY.

COMPRISING REPORT OF PENNSYLVANIA FORESTRY
COMMISSION, APPOINTED BY ACT OF LEGISLA-
TURE, APPROVED MAY 23, 1893.

J. T. ROTHROCK, M. D., Botanist Member.
WM. F. SHUNK, Engineer Member.

CLARENCE M. BUSCH.
STATE PRINTER OF PENNSYLVANIA.

1896.

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LETTER OF TRANSMITTAL.

To the Senate and House of Representatives, Commonwealth of Pennsylvania:

Gentlemen: We have the honor to present the final report of the Forestry Commission of Pennsylvania, in conformity to "An act, No. 68, relative to a Forestry Commission, and providing for the expenses thereof," approved on the 23d day of May, A. D. 1893, which requires that "the final report of the said Commission shall be presented to the Legislature not later than March fifteenth, one thousand eight hundred and ninety-five."

There remain several maps showing graphically the conclusions stated by the engineer member of the Commission. These, owing to their shape, could not be found in the volume herewith presented, and we hold them subject to your order. It is proper to add that at the expiration of the fiscal year, May 30, there will remain an unexpended balance of five thousand one hundred and sixty-seven dollars and eighty-four cents (\$5,167.84) of the appropriation under which we have worked.

We have the honor to be

Very respectfully,

J. T. ROTHROCK,
WM. F. SHUNK,
Commissioners.*

*It is proper I should add that at the time this report was delivered to the Legislature, my honored colleague, Mr. Shunk, was lying desperately ill, and that he was thus unavoidably prevented from completing his portion of the work in such a way as to be satisfactory to himself.

J. T. ROTHROCK.



INTRODUCTORY.

This report merely opens up the relations of Forestry to the Commonwealth. In the nature of the case, with the time and means at the disposal of your Commission, nothing more could be expected. We may say, though, that enough has been gleaned to show the importance of the subject to the prosperity of the State, and to indicate the need of immediate action.

We have labored industriously to cover, by actual observation, as much of the Commonwealth as possible, directing our first attention to those regions in which we supposed the largest interests were most concerned.

This is the proper place to acknowledge our profound indebtedness to the newspapers of the State and to the Pennsylvania Forestry Association for the generous assistance which they have rendered the Commission in its work. Nothing can more plainly show the growing public interest in forestry than to say that one press clipping agency in Philadelphia has sent to our office during the past year about eleven hundred newspaper notices upon the question, and that thirty-six states were represented. Out of this large number there were not more than a dozen clippings which failed to recognize the importance of the subject, and to commend it to public attention.

In the report of the botanist member of the Commission will be found contributions from Messrs. John Birkinbine, Josiah Hoopes, F. R. Meier, A. C. Sisson and Chas. W. Johnson. It is not necessary to add that they all have an intimate practical acquaintance with the subjects upon which they have written, and that the papers over which their names appear may be considered as representing the best available information.

We desire also to acknowledge the cordial co-operation of Mr. Percy W. McClellan, the Statistician of the Commission, who has conducted the correspondence of the office, and reduced a large part of the statistical matter. To Mr. A. A. Meader, of West Chester, the botanist member of the Commission is greatly indebted for assistance in systematizing the scattered information received from and collected in the various counties. He also prepared some of the most important tables. Mr. Charles S. Bradford, Jr., likewise of West Chester, has given most generous and efficient aid toward

the production of a portion of the illustrations which enforce the statements in the text. From Hon. Thomas J. Edge, Secretary of the State Board of Agriculture, and from the Department of Internal Affairs we have received assistance which was as important as it was generous. From all parts of the State, from private citizens and from public officers, we have had helpful answers to our many questions.

For information concerning such counties as we have been unable to reach in our travels, we have drawn freely upon the reports of the State Geological Survey, the reports of the Department of Internal Affairs and the report of the State Board of Agriculture for 1882, in which there are recorded many important facts, which time has not altered; and for collection of which the State is indebted to Dr. W. S. Roland, of York, whose services to the forestry interests of Pennsylvania have been vast.

THE COMMISSIONERS.

REPORT
OF
WILLIAM FINDLAY SHUNK,
ENGINEER MEMBER
OF THE
PENNSYLVANIA FORESTRY COMMISSION,
March 15th, 1895.



REPORT OF WILLIAM FINDLAY SHUNK, ENGINEER MEMBER OF THE COMMISSION.

My honored colleague having undertaken, of free grace and in virtue of superior qualifications, to treat the greater matters of forestry—set forth in the Act of May 23, 1893, relative thereto—this paper will treat the lesser matters, namely: water sheds of the Commonwealth, wild lands from which forest reserves may be selected, and the influence of woods on the flow of streams.

I.

TOPOGRAPHY.

The Commonwealth is nearly rectangular in outline. Its northern and southern boundaries are parallels of latitude 157.76 miles asunder, broken only by a jog to the lake in Erie county and a scallop at the southeastern corner belonging to the state of Delaware. Westward it is limited by a meridian line; eastward by the Delaware river, which forms along its border two quite symmetrical zigzags ranging respectively southeastward and southwestward, but on the whole southwardly. Its average length is 285.85 miles; its extreme length from the Ohio state line to the point below Trenton, 306 miles, and its area 45,096 square miles—very little more or less.

Being thus a rather artificial figure, crossed slantwise by the great natural features of the ground, which themselves are singularly diversified, we have in Pennsylvania three distinct topographical regions as shown in the annexed map. Tributaries of the Delaware pass through two of them. The Susquehanna traverses all three. Only the Ohio waters drain a territory simple in both form and structure.

The first topographical region, including all that portion of the Commonwealth between the tide-water reach of Delaware river and

the Kittatinny mountain, ascends northwestward and westward to an average elevation of about 500 feet in Kittatinny Valley, which general name may be used for the valley instead of the various local names. This region is a gently undulating plain on the whole, although its uniformity is somewhat broken by clumps of the interrupted South mountain range and low ridges parallel thereto in Lancaster and Chester counties. The wide depression of the Susquehanna valley masks a slight general rise of the country towards the southwest. The streams have a moderate rate of descent as a rule, for long distances on their lower courses, excepting Susquehanna river itself, which falls along its last twenty-seven miles to Chesapeake Bay at the rate of nearly 7.5 feet per mile.

Settlement of Pennsylvania began in this region. Kittatinny mountain was our Indian border for three-quarters of a century, and this Atlantic Plain is still more thickly peopled than any other considerable section of the Commonwealth. Inclusive of Philadelphia it averaged 264 polls to the square mile, and 142 exclusive of that city, by the census of 1890. It has an area of 8,427 square miles, for the most part cleared and cultivated. Farm wood-lots and poor hill country meagrely forested cover about twelve per cent. of its surface.

The second region, distinct by its make of ground, is a belt of ridge and hollow averaging 50 miles wide, which starts from the Delaware river, bordering Pike and Wayne counties, above Port Jervis, on a course S. 30 degrees W., curves rapidly westward parallel to Moosic and Wyoming mountains, crosses the Susquehanna S. 74 degrees W., and thence rounding down southward passes into Maryland, on a course S. 30 degrees W. again, 240 miles from the place of beginning.

The Susquehanna river parts it meridionally into two nearly equal divisions. The water floor of the western division slopes quite uniformly and moderately from the crest of the Potomac water-shed in the southern tier of counties, say 1,200 feet above tide, to the Susquehanna river, which averages 400 feet above tide on its passage across this belt.

A high divide runs diagonally through the Eastern division, from the northwestern part of Wayne county to the Susquehanna at Kittatinny Gap, traversing the middle anthracite field, and not only counter-slopes the water-sheds of that division, but stiffens the descent of the streams flowing respectively into the lowlands of Delaware and North Branch basins. It also makes the eastern division a higher country than the western.

This ridge belt, together with all the rest of the Commonwealth beyond it northwestward, shared in the uplift of the Appalachian mountain system. It appears in the making to have been a huge

welt, bulged up greatly higher than the Allegheny plateau by pressure from the southeast; striped with long rock blisters and flattened or collapsed over the Anthracite and Broad-top coal fields. No doubt it shrink-cracked in seasoning, whereby the greater channels of drainage now extant were fissured deep across its rugged surface. In the long process of time vicissitudes of climate have wasted it away, so that our existing mountains are only the low, ruined cores or springing lines of vastly greater ones which formerly arched over Nittany valley, Morrison's Cove, Kishicoquillas, Path and others of our limestone and gray shale valleys in middle Pennsylvania.

The Ridge Belt contains at least 2,400 square miles of stony, linear mountain and, in the Eastern division, 500 square miles or more of high barrens besides, fit only for timber. It has an area of 11,808 square miles, 24 per cent. of it woodland in farm lots and hill country meagrely forest-clad. By the census of 1890 its population averaged 94 polls to the square mile.

The last and largest of our distinct topographical regions is the Allegheny Upland. Although various in particulars—such as the broad mountain heaves in the south, the remarkable depression of West Branch water-floor, the promontories, spaced apart like a buzzard's wing feathers, in Tioga, Bradford and Wyoming counties and the lake-strown highland in Wayne and Susquehanna, where the Allegheny plateau knots with a similar but much smaller one at the northern end of the Ridge Belt—nevertheless, this great region is in the general view a high plain marked by characteristics peculiar to itself. It undulates, for the most part, in wide low swells and shallow swales northwestwardly and, with inconsiderable exceptions, has a gentle descent southward and southwestward in the direction of the dip in its rock beds, which dip is somewhat greater than the inclination of the ground, taken as a whole.

The removal of soft material by rain and flood from the watershed of the North Branch above Tunkhannock has left in high relief the buzzard-wing salients above mentioned. More compact surface rock preserved the highland of McKean, Potter and adjacent counties, together with the spurs, prominent outliers and mountain crests southwardly, to the Maryland line.

West of these, in the valleys proper of the Ohio and its main Pennsylvania affluents, the relief of the country is very uniform; a little varied, but not strongly marked, by the divide south of Lake Erie, the small 1,500 feet plateau in northern Butler county, a patch of the like in Washington and the flats of Conneaut and Shenango in upper Lawrence, and northward thence, near the Ohio line.

The Allegheny upland is peculiar in being a complicated hill country, formed chiefly, not by uplift resulting from side pressure, but

by erosion. The abundant streams have channeled deep. What were swales at first are now ravines and chasms. The larger waters have sunk 500—800 feet below the ancient surface and wind from side to side down narrow flood bottoms, level athwart, whence the flanking slopes rise in most cases abruptly. From overlooking heights, the land has yet the aspect of a gently rolling plain, whereas a traveler in the valleys is so beset by crowded steeps that he can get no view of the actual mountain system surrounding him. In the same way houses are said to have prevented a competent observer from seeing the town about him on a first visit to Boston.

The nearly level rock foundations have caused this peculiarity in the sculpture of the surface. The successively lower hard strata of the coal measures, which underlie a great portion of the upland, each in its turn widely exposed, furnish durable weather-caps roofing the softer beds and form extensive summit levels and long flat-top or slightly rounded divides, which are marked features of the region not less than the sunken water floor.

The area of the Allegheny upland is 24,861 square miles, equal to about 55 per cent. of the area of the Commonwealth. Its population by the census of 1890 averaged 56 polls per square mile, exclusive of Allegheny county, and 77 per square mile inclusive of that county.

About twenty-eight per cent. of its territory consists of farm woodlots, woodland various in the size and quality of its crops and high barrens.

II.

WATERSHEDS.

The important watersheds of Pennsylvania are parts of three greater ones which cross the Commonwealth from and to adjacent states, namely; those of the rivers Delaware, Susquehanna and Ohio.

Other watersheds, less important, head in Pennsylvania and drain respectively into Lake Ontario, Lake Erie, the Ohio river and the Potomac river.

The following table gives the extent in square miles of our Pennsylvania watersheds, big and little, and of the tributary basins from neighbor States:

Important Watersheds.**Delaware.**

From the New York line to Lehigh basin,	1,850 sq. m.
Lehigh basin,	1,390 sq. m.
Thence to the Schuylkill basin,	725 sq. m.
Schuylkill basin,	1,808 sq. m.
Below the Schuylkill basin,	670 sq. m.

Total in Pennsylvania, 6,443 sq. m.

There are 5,000 square miles of territory draining into the Delaware from New York and New Jersey, and, therefore, beyond our control.

Susquehanna.

North branch,	5,328 sq. m.
West branch,	6,820 sq. m.
Northumberland to the Juniata basin,	1,552 sq. m.
Juniata basin,	3,411 sq. m.
Below Juniata river,	3,895 sq. m.

Total in Pennsylvania, 21,006 sq. m.

From New York, 6,000 sq. m.

Aggregate area of the Susquehanna basin North of the Maryland line, inclusive of tributary basins from New York, 27,006 sq. m.

Ohio.

Allegheny basin,	9,550 sq. m.
Monongahela basin,	2,826 sq. m.
Ohio river basin between Pittsburgh and the State line,	2,371 sq. m.

Total in Pennsylvania, 14,747 sq. m.

From Ohio, 1,380 sq. m.

From New York, 1,700 sq. m.

From Maryland and West Virginia, 5,600 sq. m.

Aggregate area of the Ohio basin, to the State line of Ohio, inclusive of tributary basins from that and other states, 23,247 sq. m.

Less Important Watersheds.

Draining from Pennsylvania into adjoining States:

Genesee,	142 sq. m.
Lake Erie,	492 sq. m.
Conneaut,	155 sq. m.
Little Beaver,	89 sq. m.
West Virginia,	502 sq. m.
Potomac,	1,520 sq. m.
<hr/>	
Total in Pennsylvania,	2,900 sq. m.
<hr/>	

The foregoing table was derived from measurements on the map prepared by the Department of Internal Affairs and from published maps of the adjacent States. Its figures, therefore, are approximate, not accurate, as the maps were drawn to a small scale. The purpose of this report does not call for astronomical nicety in them. They reliably indicate that more than ninety per cent. of our territory is drained by the three rivers first above named, and that about one-third part of the aggregated watersheds of said rivers, including those portions of them which drain into Pennsylvania, lies upstream from us and beyond our jurisdiction in contiguous States.

In the appendix is a map of the Commonwealth illustrative of the preceding text. Other maps and diagrams follow it. They were constructed in order to save many words—graphical exhibits being a more compact and expressive language—and, it is hoped, will be found useful to that end.

The slopes and summits of our watersheds, so far as I have seen them, are in fair condition—road ditches, torrent channels and logslides excepted—and my observations have probably missed none of their varieties. But even logslides are greening over, here and there, with a thrifty generation of saplings; so healthful and energetic is nature, so potent to rise again when cast down.

Hill fields, liable to scour, are usually left fallow and they speedily reclothe themselves with seedling trees, amongst which the white pine is particularly forward. In many places cultivated slopes hold their own along the flanks of ridges and mountain spurs, wooded above them, whilst others in the neighborhood, alike in every respect but the forested crown, show signs of wash. On the other hand, summit fields rounding down into forest stand weather-proof only when forest begins at the rain-flow danger line. Thus, whether tilth be winning up or down, it shall find that prohibitory limit girding all our arable uplands. It is easy to see then that plow land may be extended upwards in proportion to the efficiency as a checkwater of

the woodland above; and that, along with the deterioration or destruction of the forest, the field below must shrivel downwards. The danger line, therefore, though unavoidable, is not immovable, and in long slopes it might obviously be duplicated by means of an intervening strip of woods.

There are still other naturally conservative agencies and the danger line varies much in its range according to the variety of soils in the shale country which constitutes the larger portion of our farming country. It sometimes does not appear on steepes, where we would presume it to be likeliest. Such lands, bestrown with flattish shivers, from the bigness of a dinner plate to that of a silver dollar, may be found rain-proof in grass on inclinations of twenty-five and thirty degrees to the horizon and are frequently cultivable on slopes of twenty degrees, without scour.

The phenomenon, puzzling at first, seems on attentive consideration to have analogy with other saving functions of both things and creatures. Rain, for example, instead of leaching the nutrient elements of vegetation from the soil, as might be expected, does really add to them. Trees, also, at every stage of growth, are endowed with surplus strength against contingencies which may never befall. Rivers, likewise, tend not only to repair during subsidence the waste caused by flood, but to protect their channels from erosion. They do it with paving stones set on edge, tilted down stream at an obliquity determined by the rush of the flood current, and orderly bestowed, in many cases, as if by the hands of man. A great number of our streams have thus reinforced their beds. To the like end, rain, on bare shaley or flaggy land, having first done its errand of washing off a film of the light surface soil, goes on forthwith to multiply resistance to its ownself by exposing and laying flat the top layer of stone chips. These, in their turn, invulnerable to the stroke of downfall and already thereby protective, so split and twist about the ever starting, ever baffled rills that they cannot get together and make head for damaging scour. Thus do even the hills, like trees and rivers, react in trial, and hold fast their integrity, and have a kind of moral significance.

Application of the foregoing remarks to torrent beds was withheld. A brief inspection of the profiles in appendix will decide that these are to be looked for on affluents of the North and West branches—the latter particularly. The object of the profiles was to illustrate only the prominent characteristics of axial waters and their tributaries. A limited selection was necessary in order to avoid confusion in the presentment. For these reasons the West branch system appears less formidable, absolutely and relatively, than it otherwise should. Open country at the heads of some of the

numerous streams, precipitate descent of lateral watersheds, lumbering operations along them all, have produced conditions favorable to the rapid discharge of rainfall into the larger channels. Sawmill waste, logs and wreckage from the timber lands cut over—the last far greater in quantity than that contributed by the virgin forest—increase the destructive violence of flood. Running separately they are injurious; but they raft together, take ground from time to time, form temporary dams which turn the current to one side or both and presently break away, causing a series of ruinous little floods on top of a big one. Little Pine creek was the worst I saw in this kind after the storm of May, 1894. It appeared to me that about half of the farming land in the valley was swept off below English Centre.

Speaking of wreckage from waste timber lands, it should be remarked that, where the forest cover is taken away or thinned to a skeleton crop and the floor burned off, as on nearly all our wild lands, rain is more apt to scour than on open pasture. The mold that survives combustion is less tenacious and grass, slow to make, seldom if ever, forms so tough a sward as in the field. Evidences of washout are much more frequent on such lands than in the open hill country. In short, good forest floor is the chief agent in conserving water and impeding its surface flow. It is the product of good forest, coeval with it, prospers with it, and once lost is very tardily recoverable.

III.

RESERVES.

Turning now to the subject of Forest Reserves, the State owns no land outside the sites of the public buildings, except the small vacancies which would no doubt be discovered in trying to match old surveys. It must, therefore, purchase the land if forest reserves are to be established. Selections may be made from the tracts of suitable territory here scheduled, which are all the large tracts of such territory we have in Pennsylvania. The land is worth from fifty cents to one dollar per acre and would probably be valued at an average of seventy-five cents per acre by just and competent appraisers.

The Pocono Tract:

970 square miles, including parts of Wayne, Pike, Monroe, Carbon, Luzerne and Lackawanna counties.

The Mehoopany Tract:

200 square miles, including parts of Wyoming, Luzerne, Columbia and Sullivan counties.

The Lycoming Tract:

1460 square miles, including parts of Sullivan, Lycoming, Tioga, Potter and Clinton counties.

The Sinnemahoning Tract:

2000 square miles, including parts of Tioga, Potter, Clinton, Cameron, Elk, Clearfield and Centre counties.

The Tionesta Tract:

300 square miles, including parts of Forest and parts of abutting counties.

The Seven Mountains Tract:

500 square miles, including parts of Lycoming, Clinton, Centre, Union, Snyder, Huntingdon and Mifflin counties.

All these tracts, though they differ as to the extent of forest remaining, agree in being for the most part natural forest land, stripped or stripping of its merchantable timber, devastated by recurrent fires, unfit for agriculture and very sparsely peopled.

Whatever may be done elsewhere or hereafter, two localities appear to challenge precedence at the outset in selecting lands for reserves. There is no alternative to the Pocono highland in the East, at the source of Lehigh river and other Delaware waters. So with Lycoming in the West. The former would be more exclusively a forest reserve, the latter, not less a forest reserve, but a flood preventive besides, of the first importance.

Delaware is quite a rapid stream, the Lehigh a wild one on its mountain course; but generally the Pocono streams descend in steps and are not liable to destructive freshets. The West Branch has a rather livelier flow for 100 miles above Lock Haven than the Delaware for an equal distance above Easton, and is exceptional every way in its peculiar fitness for begetting disastrous inundations.

Contrast the plunge of its great affluents from the Northern tableland into the main river with the long easy descent of Allegheny tributaries after issuing from that same ground. Compare also the necessary effect on the respective watersheds of prevalent rain storms from the West and Southwest. Such storms travel up stream in the case of Allegheny affluents, the floods running off behind them, paid out like ropes from the stern of a moving ship. In the West Branch watershed they travel down stream at first, keeping the flood ahead of them or carrying it with them instead of

trailing it behind; then drawing through the funnel between Allegheny mountain and the highland of the North, with a send upward into colder air, crosswise of the multitudinous drainage system, they plump the channels full, broadside to, like eavesgutters, from the Sinnemahoning to the Loyalsock. Thus 77 per cent. of the whole basin—that is to say a water-shed 5,300 square miles in extent, whose main stream descends at the rate of 6 feet per mile and the feeders at 60—delivers its torrents almost simultaneously into a nearly level reach of West Branch Valley, not more than 17 miles long, below the mouth of Pine creek. The river itself is 22.5 miles long on that valley reach, but in a great flood the valley itself becomes the channel.

It did not occur to me, while exploring the West Branch watershed, to study the delta of Loyalsock. After collecting my observations it seems probable that a bar has been formed there which ponds the river back. For the Loyalsock is a strong water in flood and comes down the last ten miles of its course at the rate of thirty feet to the mile, square to the main valley. No other one of the larger creeks flowing into the West Branch has so steep a terminal pitch. This locality therefore invites special attention from those engaged in devising plans for the protection of the valley against inundations.

Under the adverse conditions above noted, most of them irreparable by man, the Lycoming Reserve bespeaks ample space and must at its probable amplest, require to be supplemented by County or Association Reserves and artificial regulation of Pine and Lycoming creeks, if not the main river. Another consideration bearing upon the subject is that these creeks head in open country, in an arable region; hence the expediency of a generous layout for the protection of the lower courses where protection is somewhat less effective.

IV.

FOREST AND FLOOD.

Concerning the influence of forest on the flow of streams the record of mankind and living experience are at one. Both prove incontestably that springs decrease and the equable flow of rivers becomes irregular when the woods are stripped from their gathering grounds. Furthermore, although the instances are for obvious reasons less abundant, it has been demonstrated by experience that,

with the restoration of the woods, the springs break forth again and the rivers flow equably again, thereby proving a relation of cause and effect between the wood and the water. In this broad conclusion all those qualified to speak as having authority on the subject are agreed. Difference of opinion begins amongst them when they come to rank the influential agencies.

It is enough, however, for practical purposes to have learned that the forest influences the flood. The proverb says when you sell a cow you sell the milk too. So the man who plants a forest plants its functions too, which will act in due time whether the man knows of them or not beforehand. Still, it satisfies the hunger of reason, and is a benefit otherwise, to observe the chief agencies employed, which are manifest even to the wayfarer, though he be unable to rate their differing values.

The trees hinder sun and wind from drying the ground; from melting and from heaping snow. They fend the shock of beating rains. Their offcast leaves and twigs and their dead trunks decay quicker in the moist air of the forest than on the open field, forming a loose thirstful mold, sheltered and fostered by the yearly renewing ground litter. Their damp shade favors the growth of moss, another strong water drinker. The matted floor and, in winter climates, the cover of snow, keep the soil tender and open in texture, thereby promoting absorption; whereto likewise the deepgoing tree roots give furtherance, by making channels downward into the under earth. Side roots, hunching the ground like moles, and the tangled surface cumber, slacken the flow of water after heavy rains; and all these agencies, whatever other duties they may have, do work together to the one end of holding back waters which would else make flood.

If the forest be cut off, then opposite agencies come into action, which presumably must and actually do cause reverse effects, quickening flood on one hand and lengthening drought on the other.

How far, by correct and precise valuation, the presence or absence of the forest cover is effective in preventing or producing floods, is a question which science is yet unable to answer. Of all who have lived, we are the people to whom the best opportunity was given to find out an adequate answer. We came hither to a wooded country and for six generations the axe has been busy making room for corn and grass. If record had been kept, from that time to this, of cleared land and river volumes, some measurable relation between them might have been appeared. That opportunity came to pass, and passed. Records now making have not had time yet to run the whole circuit of probable vicissitude. Hence the answer to that question must be waited for, like the birth of a child or the coming of Spring.

V.

CONCLUSION.

Referring to the profiles of river stages in the Appendix, two remarks may be seasonable. First: Although such exhibits as that showing the annual fluctuations of Susquehanna river for twenty years are generally adopted, and have their special uses, they fail to represent the comparative violence of floods; for the reason that violence increases more rapidly than the height of water. Thus, if the numbers 1, 2, 3, are taken to signify stages of height in a stream, the swiftness of it at the several stages would be expressed approximately by the numbers 1, 1.7, 2.3; and the volume of water passing in a given time by multiples of the respective figures, namely, 1, 3.4, 6.9; which may be taken to represent the comparative violence of flood. A flood therefore, half again as high as the ordinary stage, would have twice the power to wear its channel, without counting the more effective wear due to sand, gravel or cobbles it might carry along.

Secondly: A profile which averages heights for a series of years, while serviceable in its way, wholly extinguishes the peculiarities of river flow, just as individual traits are merged in a composite picture, and these peculiarities are the very things we need to determine whether or not the actual volume of water sent down annually in our rivers has shrunk co-ordinately with the shrinkage of our forests. As already said it would require a larger term than we have record of to answer this question either definitely or definitively.

Respectfully submitted,

WM. F. SHUNK.

REPORT
OF
J. T. ROTHROCK, M. D.,
BOTANIST MEMBER
OF THE
Pennsylvania Forestry Commission.
MARCH 15th, 1895.



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The botanist member of the Forestry Commission desires to express his personal obligation to Hon. J. Henry Cochran, of Williamsport, for important information; to Mr. Robert S. Conklin, of Columbia, Clerk to the Forestry Division of the Department, whose technical skill and effective co-operation have been most helpful while the book has been going through the press; and to Mr. Alfred Sharpless, of West Chester, for constant help during the whole period of this investigation.

CHAPTER I.

FORESTRY.

The art of forestry is the production of the largest crop of the most desirable timber in the least time and at the least expense, on land that is unsuited for remunerative agriculture, or for profitable grazing. Such, at least, must be our definition for the present, in this country. It may happen, however, in the future that forest growth will be the best paying crop on lands which are also well adapted to either agriculture or grazing. The law of supply and demand will decide this.

It will thus be recognized that forestry is but an extension of agriculture, and that it is subject to precisely the same business laws that govern our ordinary agricultural operations, involving only a longer reach of years to mature a slower-growing crop.

Forestry, however, has a wider and, possibly, a more important side. This we reach when we come to consider forests as determining the general good, or bad, condition of the State; when an industry must be encouraged for the general welfare, an industry involving so long a period before any financial return can be hoped for that it is beyond the lifetime of an individual. For example, it is capable of scientific proof that in the absence of forests on hilly regions the soil becomes impoverished and barren, and that floods will descend from such areas to the great detriment of the regions below. It can be further shown that it is worth all that it costs to change this condition of affairs. But the change involves half a century of time, and no individual can be expected to devote his time or money to the work. It is, however, a public necessity which must be attended to, and there is no other power than the State to which it can be assigned. In fact, a primal, fundamental law is, that the first duty of the State is to provide for its own prosperous perpetuity. If it fails to do this, it fails to secure the cheerful co-operation of the citizens and to that extent encourages lawlessness and misrule, and at the same time discourages industry and frugality.

CHAPTER II.

ACTS OF THE ASSEMBLY OF PENNSYLVANIA RELATING
TO FORESTRY, TIMBER-LANDS, TREES, &c.

Act passed in 1700.
Chapter 15. Re-
corded A. vol. 1,
p. 10. Printed in
Smith's Laws, vol.
1, p. 4.

Act against felling, removing, etc., any tree or other landmark, under penalty of not less than ten pounds.

Act passed in 1700.
Ch. 81, Rec. A,
vol. 1, p. 71.
Smith's Laws, v.
1, p. 20.

Act against felling trees on another's land without leave. Penalty, forfeiture of five pounds to owner, for each black walnut tree; other timber fifty shillings each tree; and for fire or underwood, double the value thereof.

Act of March 29,
1725, Ch. 388, Rec.
A, vol. 3, p. 41.
Repealed and sup-
plied by Act April
18, 1794.

An act to prevent the damages which may happen by firing of woods.

(Provisions of this act not given in Smith's Laws.)

Act April 15, 1782,
Sec. 12, Ch. 971,
Rec. Law Bk. No.
1, p. 531. Re-
pealed by Act of
Sept. 20, 1782.

"And whereas trees growing in the public streets, lanes and alleys of the said city of Philadelphia, do obstruct the prospect and passage through the same, and also disturb and disorder the water courses and footways, by the extending and increase of the roots thereof, and must tend to spread fires, when any break out within the said city:"

Smith's Laws, v.
2, p. 51.

Commissioners to remove all trees in streets, alleys and lanes of said city. A penalty of ten pounds for obstructing the commissioners in their performance of this duty.

Act Sept. 20, 1782.
Ch. 979, Rec. Law
Bk. No. 2, p. 10,
Smith's Laws, v.
2, p. 54.

Section 1. "Whereas, a considerable number of the inhabitants of the city of Philadelphia have, by their petition, set forth that trees planted in the streets thereof conduce much to the health of the inhabitants, and are in other respects of great public utility:"

Act Apr. 15, 1782, section 12, (above) repealed.

Act April 18, 1794.
Ch. 1732, Rec.
Law Bk. No. 5, p.
221, 3 Smith 130.

"Whereas, it hath been represented, that numbers of persons are in the custom of setting fire to the woods for different purposes, thereby producing an extensive conflagration, injurious to the soil, destructive to the timber, and the infant improvements within this State:"

Section 1. Fine imposed for firing woods, not exceeding \$50, and not less than \$20; one-half to the informer, other half to the overseer of the poor of the township where committed.

Section 2. Offenders shall be also liable to civil suit.

Sec. 3. Where party's claim in civil proceedings does not exceed \$50, the procedure shall be before a justice of the peace. If defendant found guilty the justice to issue his warrant to two or more freeholders of the neighborhood to view the place damaged or inquire into the loss sustained. These to certify to said justice the extent of the damage in their judgment whereupon execution to issue for said amount, with right of appeal to the court of common pleas.

Sec. 4. If offender be a servant and his master do not pay the damages, the punishment to be imprisonment at hard labor for three months, and from thence until the cost of prosecution be paid.

Sec. 5. Act of March 29, 1735, repealed.

Sec. 5. Prosecution of cases under acts of 1700 above digested, to be in the court of quarter sessions of the county where offence committed.

Act Mar. 1, 1799.
Ch. 2012. Law
Bk. No. 6, p. 348,
3 Smith 356.

Sec. 1. Cutting or causing to be cut, timber trees, knowing the same to be growing on lands of another, without latter's consent, declared a misdemeanor, punishable by fine at the discretion of the court. Prosecution must be commenced within one year, (two years by act 1833, Sec. 11, P. L. 225. It is declared sufficient by same act that the offender knew the lands did not belong to him or to any one by whom he was authorized.)

Act Mar. 29, 1834.
Ch. 5638. Law Bk.
No. 19, p. 464.
3 Smith 283.

Supplement of Act
April 18, 1794.

Sec. 2. Justices of the peace authorized to require security for appearance at court and for good behavior in the meantime.

Sec. 3. Owners may also sue for damages, the measure thereof being double the value of the trees felled; and in case of conversion of said trees, treble the value. And no prosecution to be a bar to such suit. (See Act Apr. 8, 1833, Sec. 10, P. L. 224 when title to land comes into question.)

Sec. 4. Setting woods on fire punishable by fine of not over \$500, one-fourth to informer, residue for the use of the poor, and imprisonment not exceeding one year.

Sec. 5. First and fourth sections of Act Apr. 18, 1794, repealed.

Sec. 1. Penalties of preceding act extended to persons receiving or purchasing timber so cut, knowing the same to have been unlawfully cut.

Act April 1, 1840.
No. 99. Printed
in Pamphlet Laws
of 1840, p. 217.

Act April 22, 1850.
No. 342. P. L. 549.

Sections 1 and 3. Writ of estrepement issuable at instance of mortgagees, etc., to stay waste, in cutting down timber. Declared unlawful to remove such timber after service of said writ.

Act March 31, 1860.
No. 374. P. L.
416

Sec. 140. Firing woods or causing same to be fired, declared a misdemeanor punishable by fine not exceeding \$100, and imprisonment not exceeding twelve months.

P. L. 419.

Sec. 152. Cutting timber trees knowing the same to be growing on lands of another, without latter's consent, or knowingly purchasing or receiving such timber or any lumber made therefrom, is declared a misdemeanor punishable by fine not exceeding \$1,000 or imprisonment not exceeding one year at the discretion of the court.

P. L. 419.

Sec. 153. Removing or destroying any certain bounded tree or other allowed landmark, misdemeanor punishable by fine not exceeding \$500 and imprisonment not exceeding one year.

Act April 9, 1869.
P. L. 786.

"Whereas, there being certain mountain and other wild lands in the county of Union, which are fired from year to year, thereby destroying the young timber and causing the land to be worthless for the purpose of timber; and whereas, should such young trees not be destroyed it would add to the value of the land, in the course of twenty years, from fifty to one hundred dollars per acre, thus increasing the wealth of the county thousands of dollars:"

Firing mountain or other wild lands in Union county, punishable by fine not exceeding \$500, nor less than \$50, or imprisonment not exceeding one year or less than thirty days, or both at the discretion of the court: One-half of said fine to the informer, other half to the county treasurer.

(This act extended by Act of June 2, 1870, Sec. 2, P. L. 1317, to the counties of Schuylkill, Lehigh, Berks, Lycoming, Centre, Snyder, Luzerne and Union. Lycoming, however, was afterward exempted by Act of May 19, 1871, P. L. 950.)

Act May 4, 1869. P.
L. 1251.

Sec. 1. Declared unlawful for owners of undivided interests in timber land to cut or remove timber without written consent of all co-tenants in said premises.

Sec. 2. Unlawful sales of such to pass no title.

Sec. 3. Writ of estrepement may issue to prevent further cutting or removal.

"Whereas, it is important to the people of the State that timber lands should be protected from fire, which, owing to malicious conduct and carelessness of individuals, is causing vast havoc to the young growing timber, especially upon our mountains."

Act June 2, 1870, P.
L. 1810.

Sec. 1. Declared the duty of the county commissioners to appoint persons, under oath, to ferret out and bring to punishment all persons who wilfully or otherwise cause the burning of timber lands, and to take measures to have such fires extinguished where it can be done. Expenses to be paid out of county treasury, the unseated land tax to be the first applied to such expenses.

Act to encourage planting of trees along roadsides.

Act May 2, 1879, P.
L. 47.

Sec. 1. Anyone liable to road tax, who transplants to side of highway on his premises and adjoining cultivated fields, any fruit, shade or forest trees of suitable size, to be allowed by supervisor in abatement of said tax \$1.00 for every four trees set out. Elms to be at least seventy feet apart, locust, thirty feet and maples or other forest trees fifty feet apart. Trees must have been set out the year previous to such abatement of tax, and be at that time living and well-protected from animals.

Sec. 2. Trees transplanted in place of trees which have died, to be allowed for in the same manner.

Sec. 3. No one to be allowed an abatement of more than one-quarter of his annual road tax.

Sec. 4. Anyone cutting down, killing or injuring any living tree so transplanted, to pay to supervisors 50 cents for each tree, to be collected in same manner as road taxes.

Sec. 1. Wilful or wanton kindling of fire on another's land so as to set fire to any woodlands, barrens or moors declared a misdemeanor punishable by fine not exceeding \$300, and imprisonment twelve months, or either or both, at the discretion of the court. Prosecution to be commenced within two years.

Act June 11, 1879,
P. L. 162.

Sec. 2. On conviction of the offender, the county commissioners to pay to prosecutor \$50 in each case, as a reward; defendant to pay the same. Prosecutor to be a competent witness in the prosecution.

Declared the duty of assessors in their return of real estate to the commissioners of the proper county,

Act June 13, 1883,
P. L. 112.

at each triennial assessment to make return of all the timber land in their proper district, by specifying in separate columns how many acres each tract contains of cleared land, and how many timber.

Act June 1, 1887,
P. L. 287.

Sec. 1. "In consideration of the public benefit to be derived from the planting and cultivation of forest or timber trees," owners of land planted with such trees not less than 1,200 to the acre, to be entitled, on due proof, to receive annually during the maintenance of said trees in sound condition, the following sums from the county commissioners.

For the first ten years after the land has been so planted, a sum equal to 90 per cent. of all the taxes annually assessed and paid upon the said land, or so much thereof as not to exceed the sum of \$0.45 per acre.

For the second ten years a sum equal to 80 per cent. of said taxes, or so much thereof as not to exceed \$0.40 per acre.

For the third and final period of ten years, a sum equal to 50 per cent. of said taxes, or so much thereof as not to exceed the sum of \$0.25 per acre.

Declared lawful after trees have been planted ten years to thin out the same so that not less than 600 shall be left to the acre; but no portion of said land to be absolutely cleared of said trees.

Act not to apply to nurserymen or others raising trees for the purpose of sale.

Sec. 2. The benefits of the first section to be extended also to the owners of land which has been cleared of merchantable timber, upon their giving notice within one year of such clearing to the county commissioners that said land is to be maintained with timber: with same provisions as to the number to be maintained and as to thinning out.

The first period of ten years to be counted from the time of clearing.

Sec. 3. Any one wilfully or carelessly cutting bark from or otherwise cutting, burning or injuring any tree, plant, shrub or sprout without the owner's consent, or without such consent kindling fire on any forest or timber land or carrying into or over the same any lighted candle, lamp or torch or other fire without having the same secured in a lantern or other closed

vessel, or discharging fireworks thereon, or wilfully or carelessly making a fire on his own or other's land whereby it is communicated to the leaves, brush or timber on timber lands belonging to others, shall be subject to a penalty of \$50 for each offence with costs of suit, one-half to the party injured, the other half to the school fund of the district where the offence is committed. With provision for imprisonment if not paid or secured, for a period of not less than one day for each dollar of the penalty. And when the penalty is over \$5.00 the accused may give security to answer said complaint as a misdemeanor before the court of quarter sessions, which court, on conviction of the defendant and failure to pay the penalty with costs, to commit him to jail for a period of not less than one day for each dollar of penalty imposed.

Sec. 4. Any justice of the peace or alderman on complaint by affidavit, to issue his warrant and hear and determine the case.

Amendment of preceding act, changing penalty to a sum not exceeding \$100 for each offence, with costs of suit.

Act May 14, 1891.
P. L. 60.

Act to prevent the spread of "yellows" in peach trees.

Act May 24, 1891.
P. L. 124.

Providing for recovery of damages to trees along the public highways, by telegraph, telephone and electric light companies.

Act June 2, 1891.
P. L. 170.

Sec. 1. On petition of owner to the court of common pleas, three viewers to be appointed, whose report is to be confirmed absolutely if not appealed from in ten days.

Sec. 2. Compensation of viewers same as in case of road jurors.

This act does not apply to police or fire department telegraph lines.

Sec. 3. Repeal of all acts in conflict herewith.

Act creating forestry commission, and specifying the duties thereof.

Act May 23, 1893.
P. L. 116.

CHAPTER III.

Pennsylvania, under original natural conditions, was one of the best wooded States, if not the very best, in the entire eastern half of the Union. Not only were her forests dense and her trees large and valuable, but they comprised a variety that were of greater commercial value than could be found, probably, in any other State. To say that for years Pennsylvania stood first as a lumber producing State, and then second on the list, is but another way of expressing the same truth.

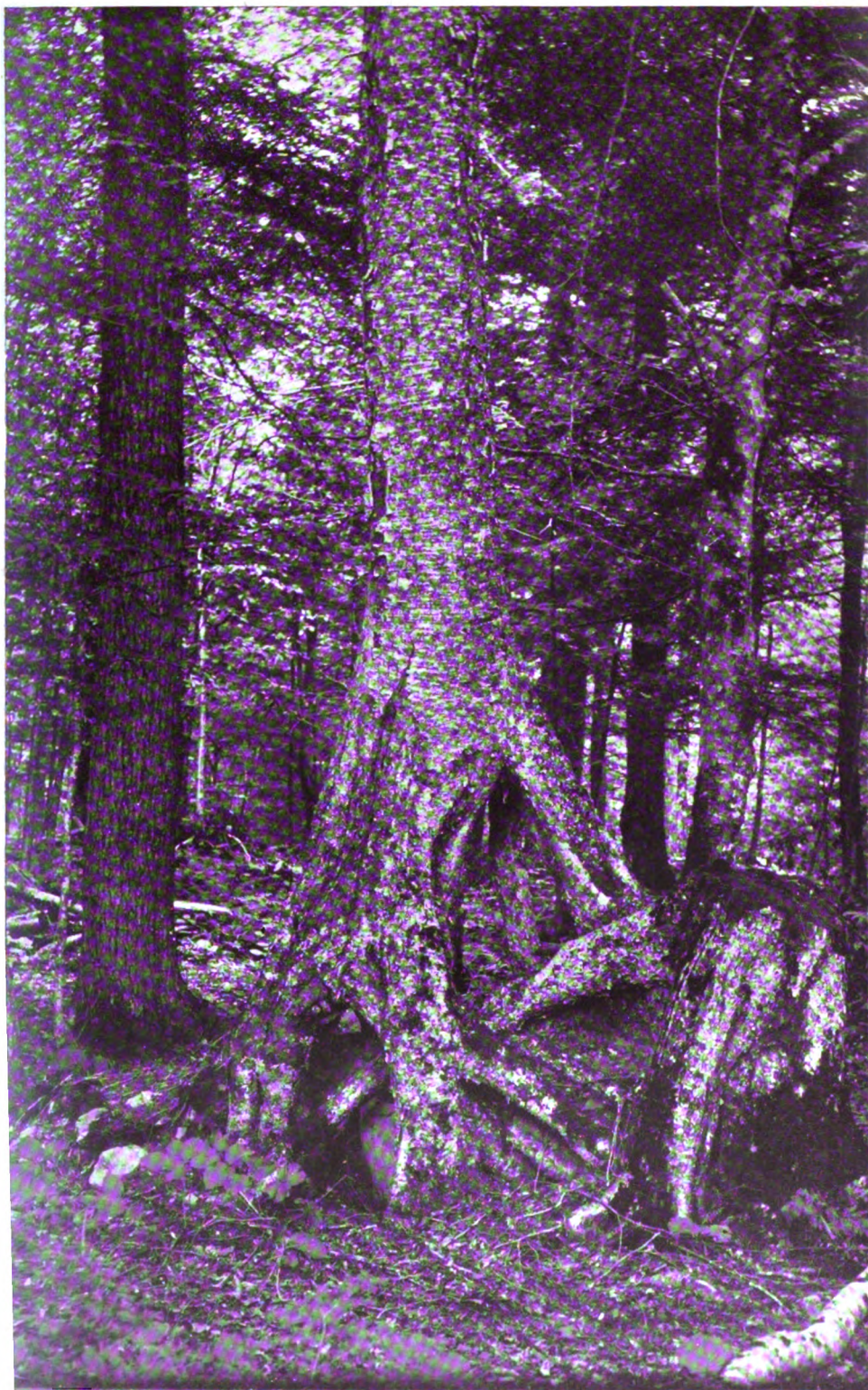
To illustrate this we have but to call to mind the fabulous quantities of white pine, hemlock, hickory, black and white walnut, chestnut, oak (of various kinds), ash, elm, beech, cherry, black and yellow birch, and latterly pitch pine, that have been consumed within the limits of the State, or exported.

It is true that a portion of her area was treeless. Here and there a lake or an open meadow occupied the surface, but these formed a very small proportion of her territory.

On the lower grounds, bordering the large rivers, in the southeastern portions of the State, the most valuable timber was white oak; or white pine in the northeastern portion. With these were associated the ordinary forest trees. Several species of hickory and birch, together with chestnut, walnut and cherry, were the most abundant. On the higher grounds, toward the central part of the State, the forests became more positively cone-bearing in character; that is, white pine, hemlock, pitch pine and occasionally Norway or red pine were more abundant than the ordinary hard woods, as sugar maple, black and yellow birch, beech and cherry, which made up the mass of the remainder of the forest. It is also true that rock or chestnut oak, chestnut and locust were exceedingly common on the rockier declivities of the mountains, and especially so on the southern border.

The altitude of the State varies between sea level and 2,826 feet above tidewater on Negro mountain, in Somerset county. This range in altitude is equivalent to a gain of one degree in latitude northward for about every three hundred feet of elevation. In other words, on the extreme altitudes of the State, say, all higher than 1,800 feet above the tidewater, we might expect to encounter the trees that are common in the British provinces. Thus, we find the black and red spruces, the balsam and the larch or hackmetack rep-

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(Plate 1. See pages 31, 176 and 266.)

Yellow Birch, Growing on Top of Decayed Stump.

resented in the primeval forest of Pike, Sullivan, Wyoming and Clinton counties.

West of the Allegheny river the cone-bearing trees never predominated, in this State. Chestnut, oak (red and white) may be said to have been the most characteristic species. In the southwest there was a mixture of our common trees with those from the region of Kentucky and West Virginia. As, for example, the honey locust and the Kentucky coffee tree. Everything considered, the sugar maple was, and is to-day, probably the most common tree in the State of Pennsylvania. That is when we remember its general distribution.

Reckoning the crop of timber which stood in Pennsylvania three centuries ago, as the lumbermen of to-day would reckon it, it may be said that a yield of hemlock of 30,000 feet board measure to the acre was not uncommon. White pine often very greatly exceeded this, and 50,000 feet board measure was no unusual yield for an acre of good timber of this species. Mixed with the hemlock, the various hard woods, such as beech, maple and birch, aggregated from two to three thousand feet additional lumber to the acre.

White pine, of the best quality was often produced on the poorest soil. The case was widely different with white oak. The latter species requiring, to produce its best timber, a rich, lowland soil. This is contrary to the general belief, but it is nevertheless true. Indeed, one must have been impressed with the idea when inspecting our primeval forests that life was superabundant; that some species, as for example, the spruces and the yellow birch, would seize upon and take possession of spots on which no other species could thrive. Thus, every possible foot of the ground was used either by trunk or roots to nourish, or bear the amazing forest growth. Plates 1 and 2 show this, where in the one instance the yellow birch is growing on top of a decaying stump, and in another where from the top of a large boulder it has sent its roots down eight feet to the soil beneath.

The air and the soil, we may reasonably suppose, were more moist in the woods than in the open ground, but there is no reason to suppose that the rainfall was greater than to-day. It is probable that the flow of water in the streams was more even than at present; that is, the difference between high and low water in the same stream was less than we find now in ordinary years. It is not to be supposed, however, that there were no stages of high water then. It is more than likely that periods of extreme high water did occur, but they were much less frequent than at present, because on the one hand the snow melting slowly under cover of the forest, did not suddenly swell the volume of the rivers, and on the other hand, most of

the rain soaked into the ground and only reached the main channel after it had come to the surface as a spring and then slowly descended as a rivulet. Even in the mountain streams the rise was gradual and quite unlike the almost instantaneous flood that characterizes the same places since the forests have been removed.



(Plate 2. See pages 31, 176 and 266.)
Yellow Birch, Growing Ficht Feet Above Ground on a Boulder.



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CHAPTER IV.

WASTE AREAS.

The most reliable official information* now available accounts for 15,973,737 acres of cleared land and for 9,099,817 acres of wood land. It is clear that there is an area of about 6,823 square miles of our State that is not included in the above estimate. There are various ways of explaining why this discrepancy exists. The assessors' lists include only farm and wood land, and omit towns, cities, mining fields, lakes, etc., and there is room for suspicion that even of the land which should have been included a portion has escaped assessment.

Of the areas not accounted for, it is most likely that the larger portion would belong to the class from which the timber has been removed, and are now known to the lumbermen as stripped lands.

However, taking the figures contained in the report of the Department of Internal Affairs, it appears that 36.29 per cent. of the area of the State is in timber. Or, to put the facts in another form, we may say, "that there are fifty-one counties whose area of timber land is less than fifty per cent. of that of the county. Of these there are twenty-eight counties whose area is less than twenty-five per cent. of the entire area of the county. On the other hand, there are four counties where the area remaining in timber is at least seventy-five per cent. of the entire acreage of the counties."

It is obvious that these figures do not convey any idea of the quantity of timber remaining. Much of what appears as timber land is not such in any productive sense. It may be producing scrub oak of no value, or white oak of great value.

An instance of this kind occurs in Oliver township, Mifflin county, where, it is reported that a large portion of its area is in timber, but it is notoriously true that it possesses almost nothing that is worthy of the name, or that would be valued by the lumberman for sale, or the mechanic for construction.

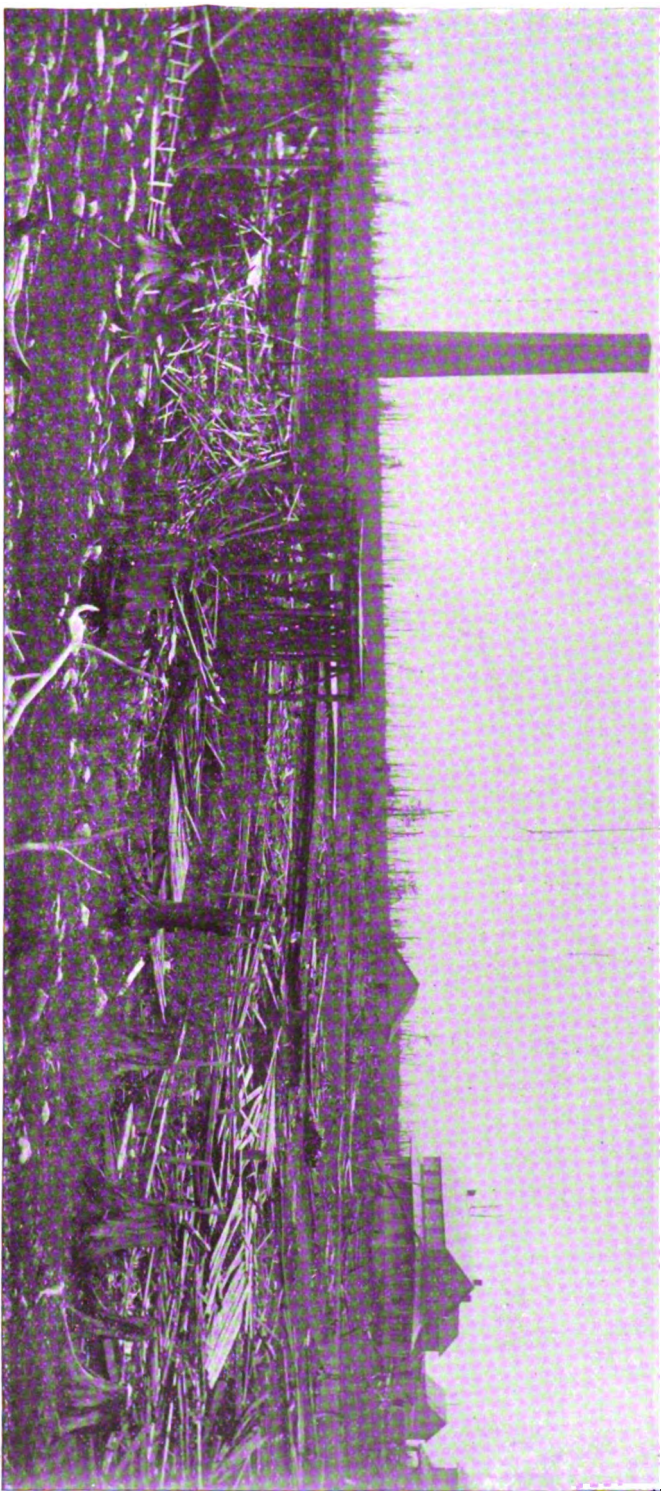
In portions of the State these unproductive areas are large and present a picture of desolation and depopulation which cannot well be recognized without awakening most serious thought as to their present and future bearing on the prosperity of the Commonwealth. For example, in those portions of Luzerne, Lackawanna, Carbon,

*The present method of making forest area returns (by the Assessors) is in urgent need of reform, while not wholly unreliable, it is unpardonably bad.

Monroe, Pike and Wayne counties, which are as a whole in most immediate relation to each other, there exists an area of about 970 square miles, or an aggregate of 620,800 acres which may be regarded more as a menace to the prosperity of the Commonwealth than as an element of strength to it. Over most of this region there was once a dense and valuable forest growth of hemlock and pine, along with the usual hard woods. A portion of this area is drained by the Lehigh and its tributaries, and those who remember the town of White Haven as it was twenty years ago will recall the number of logs that were run down the streams to, and arrested at, that point for the purpose of being manufactured into lumber. This is practically a thing of the past; and yet so recently have the lumbering interests been active in the waste area above alluded to, that I counted in the summer of 1894 thirty-six solid white pine stumps still standing on an acre of ground, and saw second rate shingles manufactured out of the portion of the same trunks that the lumbermen in the earlier years had rejected. But the most startling fact in connection with this statement is, that already yellow pine from the south is being imported into this region for home use and home construction. A superficial observer, or one ignorant of the possibilities of forestry, might well ask the question, to what use can this vast area of 970 square miles be put? It is quite clear that it is fast becoming depopulated, and that as whole its agricultural possibilities are of the very lowest grade. Not only is the soil poor, in great part, but the altitude (2,000 to 2,200 feet above the sea) of the Pocono plateau is in itself so great as to act as a further hindrance to remunerative agriculture. (See Plate 3).

Nor is this all. An area so large cannot possibly be expected to remain forever unoccupied. The coming pressure of a fast increasing population at home, and the settlement of hitherto unutilized agricultural land in the West, indicate, beyond doubt, that the time is near at hand when the area above mentioned must be made in some manner tributary to the general good of the Commonwealth.

Thus far, there has been no development of mineral wealth in this portion, nor is there any substantial reason for expecting such in the future. The only natural or possible function of the region appears to be the production of timber, and to this it is admirably suited. But in spite of the manifest destiny of the area, it continues to this day a literal barren, over which fires have swept and continue to sweep almost every year, destroying the young forest growth and rendering the soil, after each succeeding conflagration, more and more barren. It is quite certain that the inevitable tendency, under existing conditions, is to bring about the deplorable state of affairs which on the authority of the State Geologist of



(Plate 3. See page 34.)

An Exhausted Lumber Region and Abandoned Mill Site. Luzerne County.



(Plate 4. See page 35.)

Of the Original Forest, Yellow Pine Alone Remains. Centre County



New Jersey is said to prevail there. "An examination of the treeless tracts and thinly forested belts in the southern portion of the State established the fact that the desert and sparsely forested condition of those large tracts of land is due to former forest fires." See message of Governor George T. Werts for 1895.

From the region above mentioned, if we enter Southwestern Wyoming county, Eastern and Central Sullivan and most of Northern Lycoming, Northern and Western Clinton, Western Centre and a large part of Elk counties, we shall find essentially the same conditions prevailing as have been indicated above, except that in a very small part of it, especially the Western, coal, oil and gas have either been found, or the owners think they may be found. It may assist to a comprehension of the rapidity with which the condition of Pennsylvania has changed, if it is stated that in 1859 the region (in a general way) embraced between Altoona and north to the New York line, in one direction, and in the other from Renovo west to Warren, was essentially a wooded country, and that now it is in the main stripped of its timber, and a considerable portion of it agriculturally worn out. Indeed, of one of the counties (Cambria), embraced partly within those limits, Judge Barker made the statement on a public occasion that it was becoming depopulated, and that farmers were actually abandoning their farms and buildings because of the impossibility of making a living there.

Over a large portion of the now barren-ground areas to which attention has been called, we have already stated that a mixed crop of white pine, hemlock and hard woods grew formerly. It may now be in order to state that this same area has already undergone in great part two cullings; first, for the white pine, and second, for the hemlock, and the third stage, that of yellow pine, is now well advanced. Hemlock came into demand as a result of two causes. First, because the white pine was exhausted here, and second, because the hemlock was exhausted in New York state. It was not recognized as lumber so long as white pine continued abundant, and hence it was cut simply for the bark, which was to be employed in tanning. The logs in most instances were allowed to decay where they fell or to become the fuel to destroy the remaining timber when the next forest fire devastated the region. It will be worth while in this connection to note the change in the kind of lumber carried through the boom at Williamsport then and now. (See Plate 4).

In 1875 there was 190,000,000 feet B. M. of pine.

In 1875 there was 19,963,736 feet B. M. of hemlock.

In 1884 there was 154,000,000 feet B. M. of pine.

In 1884 there was 84,980,514 feet B. M. of hemlock.

In 1893 there was 33,197,267 feet B. M. of pine.

In 1893, there was 186,984,478 feet B. M. of hemlock.

The broken boom in 1894 allowed so large an escape of logs that its figures would, perhaps, not be fair to base an argument upon. This however, is clear, in 1875 there was almost ten times as much pine as hemlock rafted through the Williamsport boom. In 1893 there was five and a half times as much hemlock as pine.

One lesson of this is obvious, that the small proportion of the pine rafted is simply because the white pine is practically exterminated in the West Branch region. The other lesson is not so obvious, and one might readily infer that the large proportion of hemlock indicated an inexhaustible supply in reserve. This explanation is not the true one. The supply of hemlock is not only very limited, but none are more fully aware than those most directly concerned, that it too, is approaching extinction. The successful handling of large tanning plants makes it imperative that they should be kept at least reasonably active, and this demands a large annual cut of hemlock for bark. This, in turn, gluts the market with hemlock lumber. The end will come, and come suddenly, when both the pine and hemlock as sources of revenue to the capitalist and the wage earner of the State will disappear from within our limits. To the citizens of twenty years hence, it will appear incredible that with these facts before us, the close of 1894 showed no active measures taken for either protection or restoration of our timber resources.

What is more fully brought out in the table of "Lands advertised and sold for taxes in 1894," may be briefly stated here to advantage. Thus:

"Lands Advertised for Taxes.

"The amount of land, seated and unseated, advertised to be sold for taxes in the different counties in the Commonwealth in June, 1894, so far as heard from, was upwards of 1,500,000 acres, or 2,358 square miles. This amount does not include the 5,600 small portions of land in cities and towns advertised as lots. As thirteen county treasurers did not report, it is fair to suppose there is considerable land in some or all of these counties that ought to be added to the figures in this statement.

"These figures are taken from the printed lists furnished, or from newspaper advertisements over the name of the county treasurers received at the office of the Forestry Commission in Harrisburg.

"As the State of Pennsylvania contains 46,000 square miles of surface, it appears that almost one mile in nineteen has been offered for sale by the treasurers of the different counties. These taxes were generally for two or more years.

"Pennsylvania has 67 counties, including Philadelphia, averaging

686½ square miles each. Thirty-eight counties have less than this average, and eleven counties contain more than 1,000 square miles each. Centre county, the largest, with 1,230 square miles, and Lycoming the next in size, with 1,205 square miles, aggregate 2,435 square miles. Together they contain not quite 100 square miles more of territory than the lands advertised for taxes, not counting those advertised as lots, mineral lands, etc.

"If we compare these figures with the number of square miles in the county of Delaware (190), we discover the advertised lands to be a tract of more than twelve times the size of that county.

"A. A. MEADER."

Here, then, are the authentic figures, which show that one-nineteenth of the area of the Commonwealth is at this hour in so unproductive a condition that the owner will no longer pay the taxes on it when due. Not only this, but these figures express how much of our natural timber land is destined to become progressively more and more barren under existing conditions.

Your Commission has, as yet, no exact figures which will enable it to say how much more such land there is in the State, on which taxes have been paid. It is fair to assume that there is at least as much more, which would make the area of the State stripped of timber, which is now wholly waste or becoming worse, not less than 4,716 square miles. It may be added with a reasonable degree of certainty that this estimate is not excessive.

Agricultural lands (so-called) can hardly be regarded as coming within the scope of the Commission's work. It should, however, in all fairness, be stated that there is a large aggregate area of land that has been cleared and most of it farmed, which has already lapsed into an unproductive condition. This is due, in a very small degree, to the depressed condition of agriculture, but much more to the fact that the land is so steep and so rocky that the fertility has been washed out of it, and because it has been impossible to reach it with barnyard manure, and the farmer, or owner, was too poor to pay for artificial fertilizers. There is but one use for such land if grazing cannot be made to pay upon it; i. e., to produce a forest growth. The area of such land in the entire State can at present only be approximated. It is, however, not an excessive estimate to place it at 4,000 square miles. Thus, between lands stripped of timber and worthless, and worn out and unprofitable farm lands, we may fairly say that Pennsylvania has at this hour not less than 8,716 square miles which have ceased to be an element of strength, and that this area is becoming constantly in a worse condition.

Several remedies have been proposed, but none of these seem at present to be applicable to the whole of this vast area of barren

ground. For example, it is clearly in the interest of the Commonwealth that every acre should in some sense be productive. It is now equally indisputable that forest land is an essential to the Commonwealth. Older governments have formulated their experience in the law that where forests are more essential to the state than to the individual, the latter shall not be allowed to cut them at will. Clearly, this proposition is thoroughly "un-American," and, therefore, impossible to introduce here. The citizens may admit the proposition that forests are essential to the general well-being of the State, and then ask, how does the State propose to aid us, or pay us for raising forests for its good? This interrogation would apply with special force to such land as might produce some other crop.

And in this connection the following bill may well be entered here as an early landmark in a coming forest policy:

The following bill was introduced by Mr. Tewksbury, of Columbia county, in session of 1893, as appears by the Record:

716 Printers Number.

File Folio 3587.

LEGISLATURE OF PENNSYLVANIA.

File of the House of Representatives.

Session of

No. 702. 1893 and
1894.

Introduced by Mr. Tewksbury, in place—April 10, 1893.

Reported by Mr. Lawrence. Ways and Means. April 19, 1893.

AN ACT

Authorizing the commissioners of the various counties of the Commonwealth of Pennsylvania to make an abatement of assessments of the valuations of forest or timber lands connected with farms thereof.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same, That on and after the first day of January, one thousand eight hundred and ninety-four, the various county commissioners of the Commonwealth of Pennsylvania, are authorized and directed to make a rebate of assessment and reduction from the regular assessment from that time and for each and every year thereafter of all forest or timber lands owned in this Commonwealth, kept as part and parcel of any farm lands of this Commonwealth and occupied as such not to exceed in extent or acreage the amount so used or occupied as such farm or farm lands.

Section 2. It shall be the duty of the several assessors in the

various counties of this Commonwealth at each annual assessment after the first day of January, one thousand eight hundred and ninety-four, to certify to the county commissioners of their several counties at the same time as their regular assessment is made the amount of forest or timber land owned in connection with every tract or parcel of land occupied as farm land and used for farm purposes as described in section one of this act, which shall be the basis of abatement and exemption of assessment of taxes as provided for in this act. Provided, That the valuation per acre of any forest or timber land shall exceed the valuation of the farm land connected therewith in no case to be so exempt.

Section 3. Nothing in this act shall be construed or in any way change the laws of this Commonwealth in relation to the assessment of unseated lands, the return therefor and collection of taxes therefrom.

Section 4. All acts inconsistent herewith are hereby repealed.

The following legal opinion is of interest in connection with the tax relations of timber land:

IS EXEMPTION OF TIMBER LAND FROM TAXES POSSIBLE?

The question to be decided, as I understand it, is, whether a law exempting timber lands from taxation would be constitutional wholly or partially.

In the Constitution of Pennsylvania of 1874, there are two provisions that would seem to affect the solution of this question. These are as follows:

"Article III, section 7. The General Assembly shall not pass any local or special law * * * exempting property from taxation."

"Article IX, section 1. All taxes shall be uniform upon the same class of subjects, within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws; but the General Assembly may by general laws exempt from taxation public property used for public purposes, actual places of religious worship, places of burial not used or held for private or corporate profit, and institutions of purely public charity.

"Section 2. All laws exempting property from taxation, other than the property above enumerated, shall be void."

The framers of the Constitution thus enumerated under Article IX certain kinds of property which the Legislature could in the exercise of its discretion exempt from taxation; and beyond these, any further grant of exemption was positively forbidden. Timber

lands are not included in these favored classes. It would seem therefore that a total exemption from taxation of such lands was clearly forbidden.

A solution of the question, however, seems to present itself in the principle of classification of subjects of taxation. Grant that the Legislature has the power to place timber lands in a separate class from other lands, it then follows that it may provide for such a reduction in the taxation of the class of timber-bearing lands as to produce the good results that are here sought to be attained.

The question then narrows itself down to the plain legal proposition, whether a valid classification of real estate may constitutionally be made by the Legislature, whereby timber lands shall be placed in a class apart from all other species of land, for the purposes of taxation.

Upon this question there is an abundance of authorities. The most important of these are as follows:

"The power (of classification) existed at the time of the adoption of the Constitution; it had been exercised by the Legislature from the foundation of the government; it was incident to legislation, and its exercise was necessary to the promotion of the public welfare. The true question is, not whether classification is authorized by the terms of the Constitution, but whether it is expressly prohibited. In no part of that instrument can any such prohibition be found. For the purpose of taxation real estate may be classified. Thus, timber lands, arable lands, mineral lands, urban and rural, may be divided into distinct classes, and subjected to different rates." (Paxson, J., in *Wheeler vs. Philadelphia*, 77 Pa. 349).

"In the legitimate exercise of the power of taxation, persons and things always have been and may constitutionally be classified. No one has ever denied this proposition. To hold otherwise, would logically require that all the subjects of taxation, as well persons as things, should be assessed, and an equal rate laid ad valorem. Practically no more unequal system could be devised." (Sharswood, J., in *Durach's Appeal*, 62 Pa. 494.)

"Both real and personal estate have been classified for the purposes of taxation for a long period in the Commonwealth. Real estate has been classified for the purposes of municipal taxation into rural, urban and marsh lands, and for state purposes into seated and unseated." (*Roup's Case*, 81½ Pa. 213.)

"This power was possessed under the Constitution of 1790, had been exercised in numerous laws, and existed when the new Constitution was framed and adopted. Thus, real estate had been classified as seated and unseated, and by various kinds, as houses, lands, lots of ground, ground rents, mills, manufactories, furnaces, ferries and others. * * * These things were well known to the Con-

vention of 1873, yet no change was made in the power to classify, but it was recognized by saying that all taxes shall be uniform on the same class of subjects within the territorial limits of the authority levying the tax; by the latter clause even extending the power to classify by limiting the class to certain bounds." (Agnew, C. J., in *Coal Company vs. Commonwealth*, 79 Pa. 105.)

In the recent case of *Ayars' App.*, decided in 1888, Mr. Justice Sterrett said (122 Pa. 276):

"Classification is not expressly forbidden by the Constitution. On the contrary it is distinctly recognized for certain purposes. For example, Article IX, section 1, declares, 'All taxes shall be uniform upon the same class of subjects, within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws.' Thus, by necessary implication authority is given to classify property for the purpose of taxation, but by express mandate of the last clause above quoted, all taxes must be levied and collected under general not special or local laws." On the other hand (page 281), "The underlying principle of all the cases is that classification, with the view of legislating for either class separately, is essentially unconstitutional, unless a necessity therefor exists—a necessity springing from manifest peculiarities, clearly distinguishing those of one class from each of the other classes, and imperatively demanding legislation for each class separately that would be useless and detrimental to the others. Laws enacted in pursuance of such classification and for such purposes are, properly speaking, neither local or special. They are general laws, because they apply alike to all that are similarly situated as to their peculiar necessities. All legislation is necessarily based on a classification of its subjects, and when such classification is fairly made, laws enacted in conformity thereto cannot be properly characterized as either local or special. A law prescribing the mode of incorporating all railroad companies is special, in the narrow sense that it is confined in its operations to one kind of corporations only; and by the same test a law providing a single system for organization and government of boroughs in this State, would be a local law; but every one conversant with the meaning of these words, when used in that connection, would unhesitatingly pronounce such statutes general laws. But, as was said in *Scowden's App.*, 96 Pa. 422, 'classification which is grounded on no necessity and has for its sole object an evasion of the Constitution' is quite a different thing."

In the *American Law Register and Review* for August and September, 1893, vol. 32, Nos. 8 and 9, Charles Chauncey Binney, Esq., has considered this question with much exhaustiveness. Following are passages that cover our case particularly:

Page 725. "A general law is one which applies to and operates uniformly upon all members of any class of persons, places or things, requiring legislation peculiar to itself in the matter covered by the law."

Page 730. "The principle underlying all these cases is the same, viz., that though the law might operate within a restricted territory, it affected a large number of people, treating them simply as members of the community and without any distinctions among them as individuals; or, in other words, that the law was for the public benefit, not for that of particular individuals." As instances of such laws are cited acts for the preservation of fish in certain specified rivers, (*Burnham vs. Webster*, 5 Mass. 266, etc.); regulating the putting of pine timber into the Connecticut river, (*Scott vs. Wilson*, 3 N. H. 321, etc., etc.)

Page 817. "Whatever legislation is enacted for a class, must apply to it in respect to certain common characteristics of its members, and must be itself such as it would be inexpedient to enact for other individuals not possessing those characteristics."

Page 822. "That an equal rate should be laid upon all subjects of taxation, persons as well as things, without taking account of essential differences, would produce the greatest inequality. It is absolutely necessary to classify both persons and property for taxation, making the law uniform for each class, in order to distribute the burden equally, and in proportion to the benefit received by each class from the expenditure of the money raised by taxation, or in accordance with some other just rule. (*Durach's App.*, 62 Pa. 491; *Butler's App.*, 73 Pa. 448; *Roup's Case*, 81* Pa. 211; *Hare's Am. Const. Law*, 296)."

Page 823. "Such classification may even be resorted to, as in the case of liquor dealers, for the purpose of restricting the membership of the class, if required by public policy."

Page 823. "If the characteristics of a class be real, and really call for distinctive legislation, it cannot matter whether they have hitherto been taken into account by the Legislature or not."

Page 827. "No comprehensive statement of what constitutes a valid classification is to be found in any one reported case, though they all agree that it must not be arbitrary."

Page 828. "All classification must be based upon substantial distinctions, which make one class really different from another."

In *Ayars' Appeal* cited above (pp. 3 and 4), we have the criterion clearly stated, viz., a necessity for classification, "a necessity springing from manifest peculiarities, clearly distinguishing those of one class from each of the other classes, and imperatively demanding legislation for each separately, that would be useless and detrimental to the others."

That in the case of timber lands there is such a necessity for

separate classification, springing from characteristics that are peculiar to this kind of land, and that clearly distinguish it in its needs from all other kinds of land, and that therefore our case comes within the fundamental principle above laid down, can admit of but little doubt when the following facts are considered:

(1). That the welfare of the Commonwealth demands that the present wholesale destruction of our forests shall cease, and that there be inaugurated a policy of encouragement of the growth of timber on lands now idle and fit for nothing but timber culture. This urgent need is demonstrated by science.

(2). That timber lands now bear a disproportionate burden of taxation, being taxed equally with cultivated lands, but from the slow growth of the timber the relative income being very unequal. As it is now, the tax in about twenty years amounts to the value of the timber land itself.

(3). That as a consequence, owners of such lands care little for the preservation of the timber. Forest fires are frequent. Let this be compared with the farmer's solicitude for the grass or wheat field, and the wide divergence of conditions appears at once.

(4). For the same reason growing timber is now considered worthless when young. With a considerable reduction of tax, timber culture would become a profitable industry.

(5). Lands now waste, and valuable for nothing else, would in the same way become valuable for timber culture, and the area of forest lands thus greatly increased.

Potent additional reasons will occur to the advocate of the measure.

In these ways the growth and preservation of our wooded lands would be fostered. This brings us to the question of the demands of public policy. Science teaches that the citizens a hundred miles from the forest area is as much benefited by its preservation and enlargement as the inhabitants of the timber districts themselves. It thus becomes a question affecting the interests of the whole State, and the accusation of local or special legislation is still further repelled.

That the Commonwealth is now engaged in a suicidal policy in encouraging the diminution of the forest areas, has been clearly demonstrated by scientific experts; and if under the broad scope and wise latitude allowed by the courts in the interpretation of the demands of an enlightened public policy, a remedy for this great evil cannot be enforced, then the true reason for the existence of government has ceased, and the Commonwealth exists no more for the welfare of all, and for its own continued existence and prosperity.

J. CARROLL HAYES.

West Chester, Pa., January 5, 1893.

CHAPTER V.

STATE FOREST LANDS.

One of the specific duties with which the Forestry Commission was charged was to ascertain what lands, if any, possessed by the State could be used as forest reservations; or, if none such were found, then what lands within the limits of the State should the State possess. The following correspondence and reports from the counties will show that an effort has been made to perform this duty. It is clear, first, that no great body of land remains anywhere as the property of the Commonwealth; and, second, that the only way of discovering what there is, would be to plot all private lands on a county map, and the remaining fragments would represent the public or State property within that county.

The conviction is fast growing in this country that it is unwise in a State or general government to allow all lands to pass out of its possession. There are certain surface functions depending on the configuration and character of the highlands, for example, which concern the whole people, and for this reason should be under control of the public rather than of the private citizen. The following table will show that if this State is to have any such property, it must be by direct purchase or by exercise of the right of eminent domain.

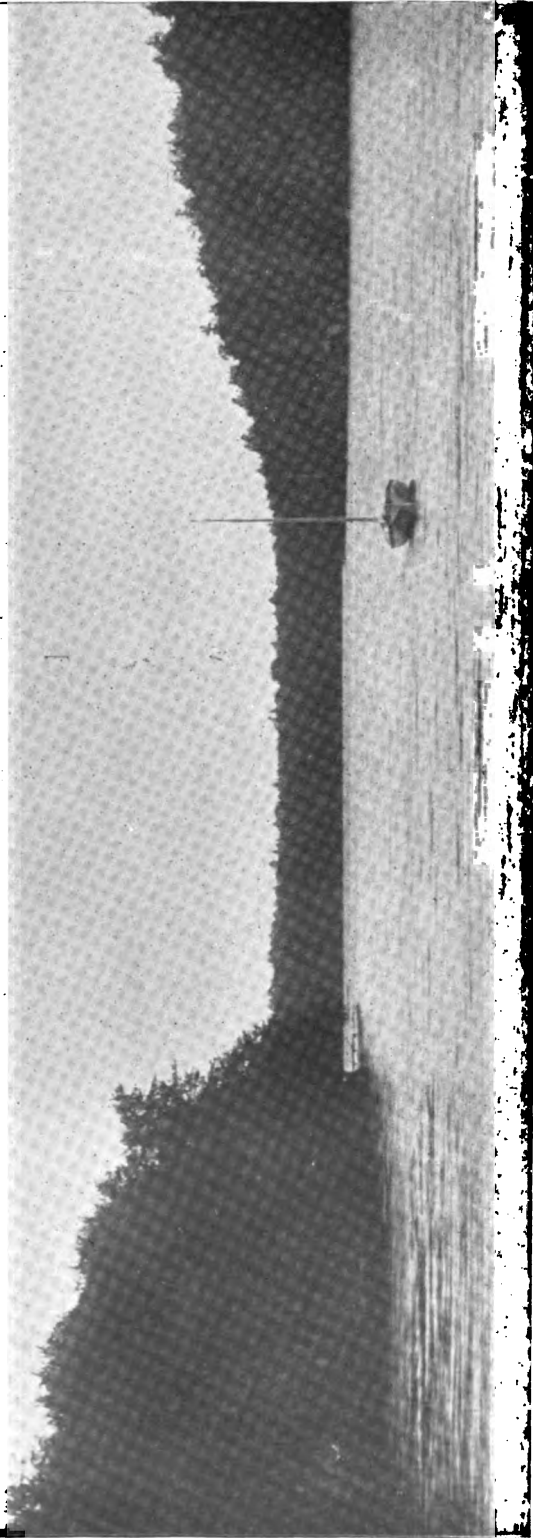
The question is thus narrowed down to one of acquisition of suitable lands, and naturally the first inquiry is, do any such lands exist within the limits of our State? This, of course, depends upon what the prospective functions of the reservations are to be in relation to the State. We should expect them,

First, To be capable of producing some crop which would compensate the State for cost of purchase and of maintenance.

Second, That they could be kept under such control as would lead to diminishing the frequency and severity of freshets on the one hand, and on the other, that they should aid in maintaining an even flow of water to foster our industries and feed our springs and streams.

Third, That these reservations should combine in themselves not only charm of scenery which would attract our population to them, but that they should also possess such altitude, purity of atmosphere and general health-giving conditions, as would make them sanitariums for those of our population who did not desire to, or could not go to remoter points for renewal of strength.

Fourth, To fill the largest measure of usefulness prospectively, due regard should be had to the capacity of such reservations to



(Plate 6. See page 46.)

Ganoga Lake, Sullivan County. Altitude, 2,220 feet above Tide.

serve as collecting grounds for the water which the cities of the future might require; and also (this is not remote) as furnishing water fall for generation of electrical power which may be carried to points more or less distant for use. Two conditions enter into this, first, sufficient supply of water, and, second, sufficient fall to utilize it.

With these points in mind we may inquire whether such areas can be found within the State limits.

First, bisect the county of Pike by a line drawn northeast and southwest, and we should have an air line of about twenty-five miles. Allow an average width of five miles on either side of the above line and it would mean an area of two hundred and fifty square miles, which would meet all the above conditions.

1. In the past it has produced large quantities of timber. It would do so again, if fire were kept off. It is good for no other crop.

2. The character of the soil and surface is such as would conduce to satisfactory results in conservation of water by well-known engineering methods.

3. That the scenery is attractive, is proved by the number of visitors to the region. That it is possessed of all the requisites for a sanitarium is also abundantly proved.

4. The Shohola creek, the Bushkill, the Blooming Grove and the Wallenpaupack all head, wholly or in part, within its limits. A score or more of considerable sized lakes of pure water dot the surface. The altitude would range from about eight hundred feet above tide to about twenty-one hundred feet. The falls and rapids indicate the capacity of the region for generating electrical power. It seems that all of the required conditions exist within this area of two hundred and fifty square miles. (See frontispiece).

If now, from the centre of the southern part of Greene township, in Pike county, a line be drawn thirty miles (a little south of west) to Bear Creek in Luzerne county, another ten miles wide strip might be obtained in all respects similar to the one in Pike county, except that its lakes and falls would be less numerous, and we should be on the waters of the Lehigh (equally pure), instead of on those of the Delaware. Here then, is another area of three hundred square miles.

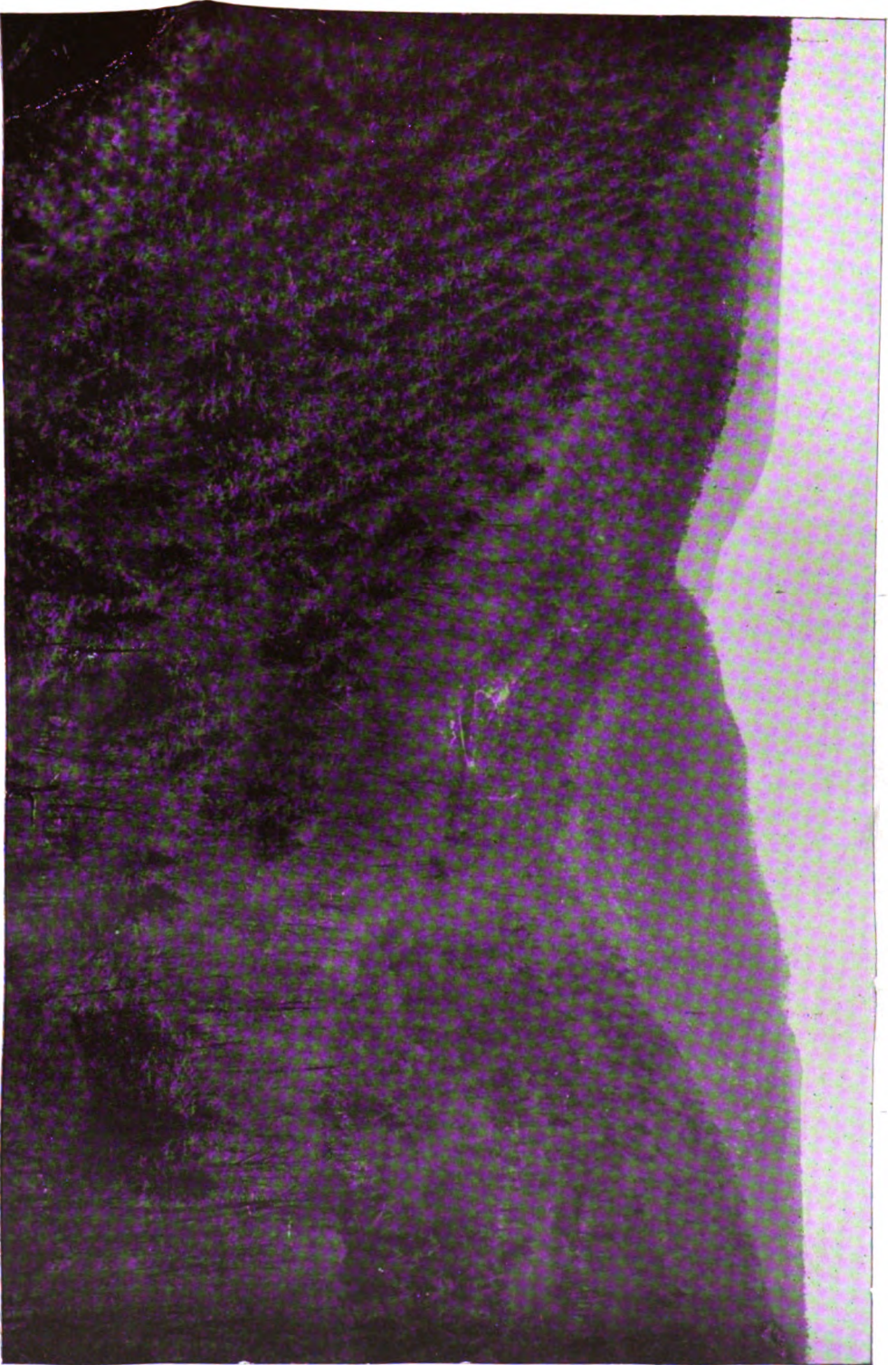
Take eighty square miles from the southwestern corner of Wyoming county, add to it twenty from the northwestern part of Luzerne, and twenty more from southeastern Sullivan, and there will be one continuous area of one hundred and twenty square miles. This, while it can hardly be considered an important water-shed in comparison with some others, is nevertheless a most important area for a future reservation, because it represents a table land that is unfit for remunerative agriculture, is well adapted to the growth of

trees, is one of the most healthful parts of the State, possesses lakes and waterfalls, and is, by virtue of the latter, capable of producing enormous electrical power. (See Plates 6, 7 and 8).

Or, going westward, take Celestia, in Sullivan county, draw an imaginary line thence to Forksville (about seven miles), thence southwest ten miles to the Lycoming county border, thence ten miles southeast via Hunter Lake to Sonestown, thence to the starting point, Celestia, and there would be embraced an area, approximately, of fifty square miles, including the celebrated and beautiful Eaglesmere region. This area could be increased considerably by extension northward from Celestia to the North Branch of the Loyalsock. In all, it is fair to assume that an area of seventy-five square miles could be had here well adapted to the purposes of a State reservation. The only objections would probably rise out of the fact that the region is already so attractive and so well known that it might be fairly considered preoccupied.

The future will probably prove that if the entire northern third of Lycoming county were under control of the State as a forestry reservation it would be for the best interest of that portion of the valley of the West Branch which is immediately above and below Williamsport. Not less than six streams rise wholly or in part within the limits of this area. It is practically an exhausted area to-day. The report of my colleague, Mr. William F. Shunk, will show clearly its relation to the destructive freshets of the West Branch. It is for me simply to emphasize the fact that as it once produced an enormous quantity of valuable timber, it can be made under State control to do so again; and also to add that if it fails to do this, it will remain of but small value to the Commonwealth. There is in it an area, approximately, of four hundred square miles.

Southeastern Potter county and Northwestern and Western Clinton county furnish an area of about two hundred and fifty square miles, which either are now, or soon will be, almost valueless, except for prospective timber growth. Several more or less important streams head within this area. That is, they are important now mainly from the contributions they bring in to swell the current of the West Branch in times of a general freshet. Kettle creek especially rises to a dangerous height frequently and suddenly. In this area there are towns, railroads, some good farms and some coal mines. The question of vested rights would be a serious one. It is, however, claimed that considerable-sized areas of suitable shape for economical management could be had within the limits above indicated, and that in view of the relation of the districts to the destructive inundations of the West Branch, and also in view of the fact that it has but little agricultural possibility, the State should under some conditions acquire a more or less complete control of the area under consideration.



(Plate 7. See page 46.)

View down Fishing Creek, from North Mountain, Sullivan County.



Northwestern Centre county also affords an area especially desirable as a reservation. (See Plates 9, 21, 22 and 23).

In Forest, Warren, McKean, Elk, Clearfield and Cameron counties, there are no doubt extensive areas that would be better adapted to produce timber than any other crop. The problem, however, for these counties is complicated by another element—that of underlying wealth, whether coal, oil or natural gas. The time will come in all probability when these will cease to be factors.

I do not think it would be wise for the State to attempt to control land for the purpose of encouraging timber growth, while any of these underlying products are to be sought. Mining operations of any kind under any known system of control, would be so likely to destroy the young timber growth that the purpose of the reservation would be defeated.

There are doubtless other areas along the southern counties in the western half of the State which it would be to the advantage of the State to own, but of these I am unable at present to speak from personal observation; though it is quite certain that ample provision should be made in time, to supply abundant water flow for the fast growing needs of Pittsburg.

Quite apart from any reservations of doubtful value, there have been indicated areas aggregating about fourteen hundred square miles of which, if we would acquire every acre, our reservations would be only five-sixths of the area that New York already possesses, while at the same time she is seeking to add to her extensive domain. This is the proper place to add that well-attested statistics prove the Adirondack region is in no respect superior in the healthfulness of its climate to either of the reservations suggested for our own State.

All State policy must rest on the ultimate basis of cost. The problem under consideration—shall the State take measures for the acquisition of a public forest reservation—is no exception to the rule. We have the example of our neighboring state, New York, as a guide. It is the more fortunate for us that New York is under conditions of soil and climate very similar to our own. I therefore quote from the report for 1893 of her Forest Commission, page 16, Vol. 1.

“Reference has been made here to the revenues obtainable from the preserve, and their availability for the payments of interest on the bonds. We should state right here that the possibility of obtaining large revenues from the State forest without injury to the same is no longer a theory, but a fixed fact. This has been demonstrated by the offers made to this Department to purchase spruce trees, twelve inches and upwards, on lands which had been cut over twenty to twenty-five years ago. One-third of the Adirondack wilderness is a lumbered forest in which lumbering operations have been car-

ried on in the past, but which to-day retains, uninjured and unimpaired, all its functions as a protective forest, and shows no diminution in the quantity of its timber or foliage. It will readily appear that if the State should acquire the virgin forest also, there would be not only an increased area of productive lands, but an increased revenue per acre.

"As previously remarked, you are not asked to make an expenditure, but an investment—an interest-bearing, revenue producing investment. This all important distinction must not be lost sight of for one moment in considering this question. It is strictly an investment—one convertible into cash at any time, for the lands can always be sold for what they cost. Its safety and desirability is evident from the favor with which it has been regarded by capitalists, some of whom have not hesitated to invest hundreds of thousands of dollars in this very property. The sure revenues derivable are clearly apparent in the management of the Adirondack League Club, whose returns are derived without injury to their forest or diminution of its areas. If some state comptroller were to deposit four millions of his funds in bank, on interest, and at the same time secure to the people additional benefits of incalculable value, his action would be applauded. We ask no more in this measure.

"In making this oft-repeated proposal for the acquisition of the Adirondack forest, we fully realize the momentous character of the legislation involved. But we also feel that in doing less we should fall short of our duty to the State, and neglectful of the interest intrusted to us. Further delay in securing this territory will only result in further diminution of our forest area, together with enhanced prices for the remainder. Such results must surely engender severe criticism in the future. We can only put ourselves on record and await the result."

This was written a year ago. Since then the citizens of New York have in the most unqualified manner endorsed the actions and sentiments of its progressive Forest Commission. If a sensible fire law for the protection of our forests be given, every word of the above statement will apply as well to Pennsylvania as to New York.

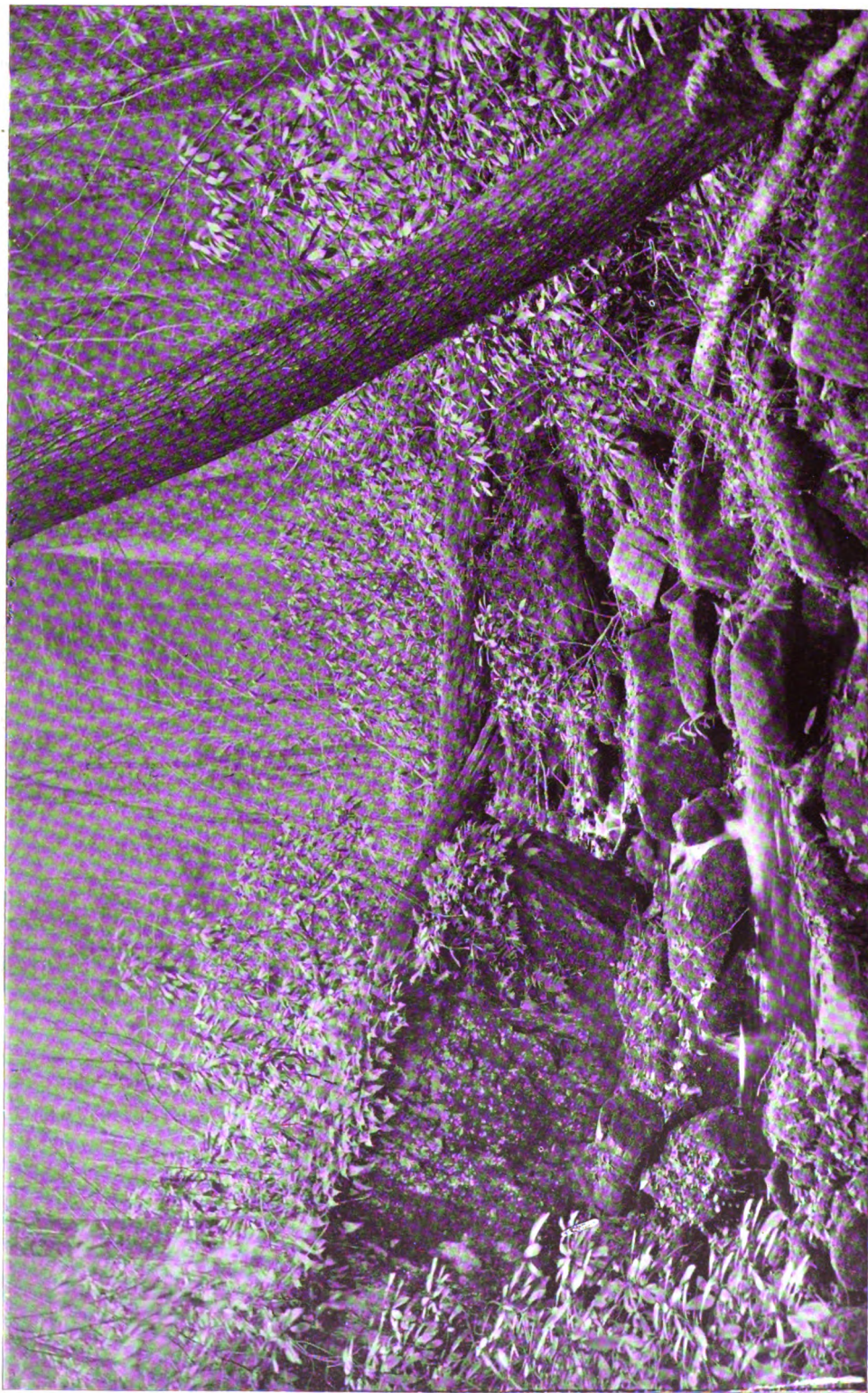
We most respectfully commend the enlightened public policy of our neighboring state to the citizens and public servants of our Commonwealth.

We are met here by the inquiry, why purchase lands, or acquire by right of eminent domain any property against the will of the owner, when there is so large an area sold each year for taxes? The inquiry is pertinent and the statement is correct. Land might be thus acquired, and in quantities so large as to astonish even those who start the question. That there may be no doubt upon this point, I append herewith a table of Treasurers' sales for taxes of land



(Plate 8. See page 46.)

On Ganoga Creek, Sullivan County.



(Plate 9. See page 46.)
Spruce Run, Centre County.

in the Commonwealth of Pennsylvania during the year 1894. It will be seen that there were sold in this State no less than 1,509,159 acres for taxes, which aggregated \$290,386.13, an area equal to one-nineteenth of the area of the Commonwealth.

DEPARTMENT OF AGRICULTURE.

COUNTIES.	LAND ADVERTISED AND TO BE SOLD FOR TAXES IN 1894.			
	Acres.	Lots.	Taxes.	County Treasurer.
1. Adams,	None.	.....	.....
2. Allegheny, .....	.....	.....	.....	No report.
3. Armstrong, .....	.....	.....	.....	No report.
4. Beaver,	855	289	\$1,907 50	C. C. Hazen.
5. Bedford,	12,515	.....	636 73	S. A. Cessna.
6. Berks,	None.	.....	.....
7. Blair,	33,039	1,329	3,478 45	W. W. Yon.
8. Bradford,	2,328	.....	476 30	F. D. Kerrick.
9. Bucks,	None.	.....	.....
10. Butler,	674	.....	.....	No tax reported.
11. Cambria,	69,847	635	22,112 62	F. H. Barker.
12. Cameron, .....	.....	.....	.....	No report.
13. Carbon, .....	.....	.....	.....	No report.
14. Centre,	70,996	13	3,090 59	Jas. J. Gramley.
15. Chester,	None.	.....	.....
16. Clarion, .....	.....	.....	.....	No report.
17. Clearfield,	None.	.....	.....
18. Clinton,	40,317	.....	3,407 77	Geo. R. McCrea.
19. Columbia,	None.	.....	.....
20. Crawford, .....	.....	.....	.....	No report.
21. Cumberland,	None.	.....	.....
22. Dauphin,	13,540	713	2,892 05	Chr. W. Lynch.
23. Delaware,	None.	.....	.....
24. Elk,	170,846	65	37,078 83	
25. Erie,	937	250	2,478 85	
City of,	5	103	2,024 95	
26. Fayette, .....	.....	.....	.....	No report.
27. Forest,	81,274	.....	24,243 38	Q. Jamieson.
28. Franklin,	None.	.....	.....
29. Fulton,	None.	.....	.....
30. Greene,	None.	.....	.....
31. Huntingdon,	7,632	.....	531 43	Geo. M. Green.
32. Indiana,	7,008	.....	.....	Tax not given.
33. Jefferson,	44,471	217	10,776 19	John Walte.
34. Juniata,	None.	.....	.....
35. Lackawanna,	4,874	28	3,127 01	D. W. Powell.
36. Lancaster,	None.	.....	.....
37. Lawrence, .....	.....	.....	.....	No report.
38. Lebanon, .....	.....	.....	.....	No report.
39. Lehigh,	None.	.....	.....	No report.
40. Luzerne,	51,537	.....	6,546 89	Wm. T. Reed.
41. Lycoming,	161,284	12	16,297 85	S. C. Updegraff.
42. McKean,	189,968	.....	49,086 30	Geo. C. Fagnan.
43. Mercer,	None.	.....	.....
44. Mifflin,	None.	.....	.....
45. Monroe,	52,512	.....	3,077 47	F. W. Ellenberger
46. Montgomery,	None.	.....	.....
47. Montour,	None.	.....	.....
48. Northampton,	3,001	196	733 97	
49. Northumberland, .....	.....	.....	.....	No report.

COUNTIES.	LAND ADVERTISED AND TO BE SOLD FOR TAXES IN 1894.			
	Acres.	Lots.	Taxes.	County Treasurer.
50. Perry,	None.	.....	213 62	W. B. Anderson, clerk.
51. Pike,	6,773	.....	386 45	J. R. Westbrooke.
52. Potter,	146,199	33	38,037 52	Chas. Coates.
53. Schuylkill, .....	.....	.....	.....	No report.
54. Snyder,	None.	.....	.....	.....
55. Somerset,	59,625	100	7,767 32	E. E. Pugh.
56. Sullivan,	42,193	126	9,806 48	A. L. Smith.
57. Susquehanna,	None.	.....	.....	.....
58. Tioga, .....	.....	.....	.....	No report.
59. Union,	33,983	8	1,225 02	D. P. Higgins.
60. Venango,	39,321	.....	8,770 52	M. R. Paden.
61. Warren,	86,994	.....	13,084 29	A. W. Jones.
62. Washington,	None.	.....	.....	.....
63. Wayne,	12,096	22	1,616 26	Wm. C. Norton.
64. Westmoreland,	22,679	1,473	10,837 01	W. H. Saam.
65. Wyoming,	39,836	.....	4,636 51	Albert G. Overfield.
66. York,	None.	.....	.....	.....
	1,509,159 or 2,358 sq. miles.	5,612	\$290,386 13	

The chief objection to obtaining lands by simply paying the taxes would be that it would saddle upon the State a large area which would be in so scattered a form that it would be difficult and expensive to manage, and liable by escape of fires into private property to become a cause of vast expense to the Commonwealth. It would, besides, often put the State in possession of lands which never could be of the slightest service to it. It would, it is true, lighten the burden, to the counties, of carrying lands from which they receive no income, and so directly aid the most needy of them, but whether such aid would be favorably regarded by the rest of the State remains an open question. (See Plate 10).

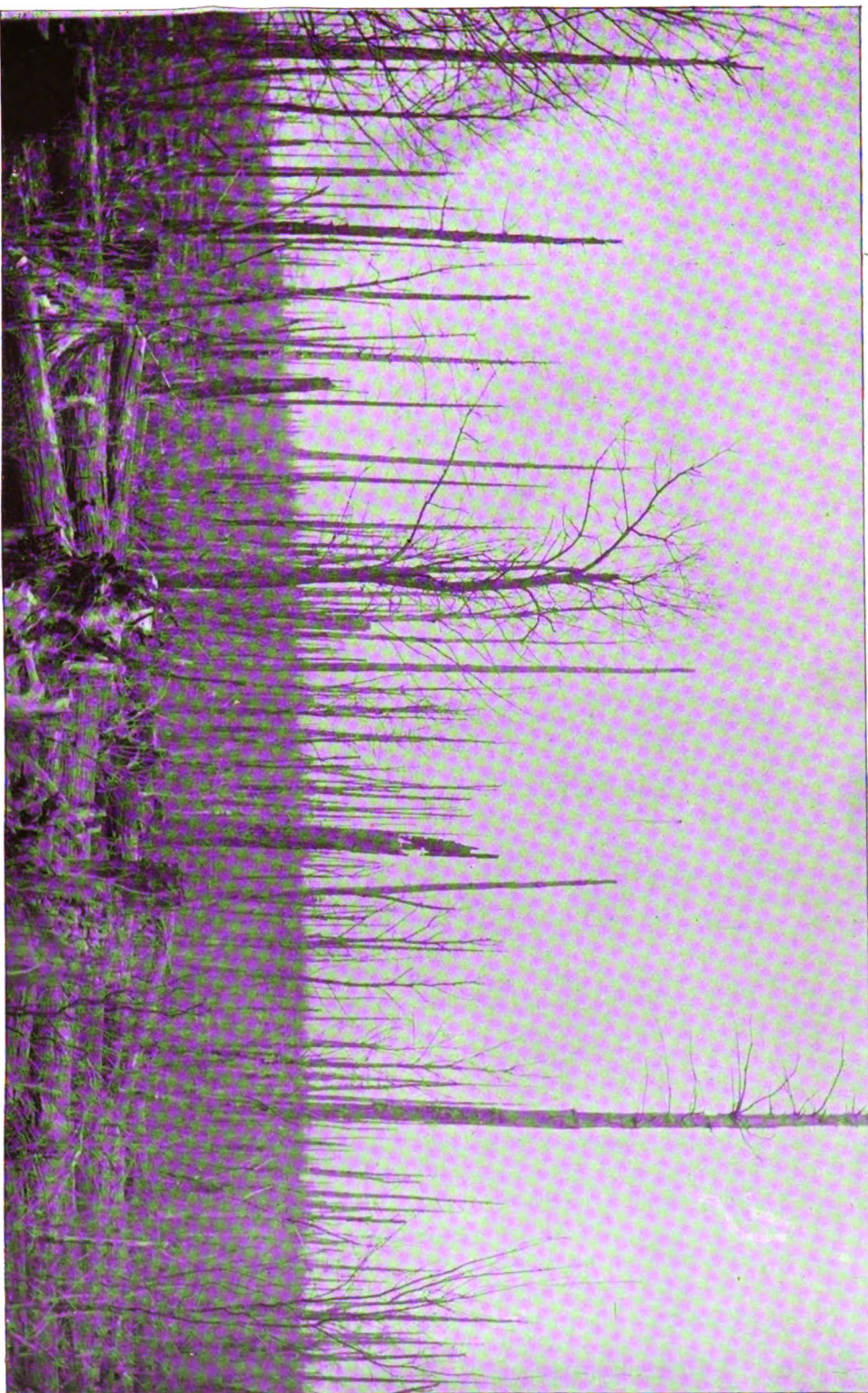
On the whole, probably the more promising, and, in the end, a cheaper method would be to select compact, suitably located reservations and take possession by purchase, or by right of eminent domain, and then keep the fire off.

If this is ever to be done, the sooner it is commenced the better, for the following reasons: There is already a well founded belief that these waste acres which can be bought now for a very small sum will shortly become valuable for speculative purposes. Your Commission is already in possession of facts which indicate this beyond doubt. Land that is in the market now at a dollar an acre, will probably in the near future command at least double that.

Further, each year of delay and neglect of the lands finds them in a more impoverished condition and the work of restoration and production of the profitable growth of trees will be slower, less satisfactory and more expensive.

If this is true, then it would appear as though delay were a false economy. The plea that the surplus money of the State is in demand for charitable and educational institutions will always exist. There has not been for years, and there will not be so long as the State endures, a session of the Legislature at which every penny, and more, of the available funds will not have been demanded for this or that interest which lies beyond the direct control and ownership of the Commonwealth. It would appear then, as if it were the part of wisdom, to act as speedily as may be in securing these State forest reservations.

The public seems to be slowly but surely reaching the conclusion that it is essential for the continued prosperity of the Commonwealth that the watersheds of the State should not be subject wholly to whim, caprice or interests of the private individual, because it is from these that the streams come, on which so large a portion of the general prosperity depends. Germany, Switzerland and France have all recognized the importance of the watersheds to the general good and place them under a certain, more or less complete control. Indeed, we may say, that we have in the United States, at the present



(Plate 10. See page 52.)

Land Stripped of its Best Timber, then Abandoned to Fire. Anderson's Creek, Clearfield County.

time, a most remarkable illustration of complication and possible future trouble growing out of an unjust distribution of water. Kansas and Nebraska on the east, and Utah on the west side of the Rocky mountains were all of them settled prior to the occupation of what is now known as Colorado. The prosperity of these three states to a certain extent depends upon the water flow which originates within the present limits of Colorado, but the state last named has the absolute power to use or abuse, to hoard or to waste this water which is essential for purposes of irrigation in the other states.

Already complaints have been made of a destitution of water within the limits of these earlier settled states.

It is very clear that such a condition of affairs, as population becomes more dense and water rights more valuable, in these states, must lead to serious complications. This has been generally recognized by the leading statesmen of the country, but how legally to rectify and right the existing wrong is a most perplexing problem. We are, to a certain extent, in the same condition here to-day. It would be quite possible for the State to acquire whatever lands it might need to guard all its future citizens in relation to this water problem. The time, however, will speedily come when these lands will be taken up by speculators and it will be very difficult for the State to acquire possession without an arbitrary exercise of right of eminent domain.

This leads naturally to the inquiry as to whether it would not be the part of wisdom in the State to make industrious search for what little remaining land it yet might possess and allow no more of it to pass into private hands.

The following correspondence will show that your Commission has made faithful efforts to ascertain what lands the State actually does possess, but there are many complications existing which have prevented our acquiring the desired information.

It would probably be wise to offer the several county surveyors a small remuneration for every acre of land now belonging to the State, which they might definitely locate.

August 3, 1893.

My Dear Sir:—The act approved May 23, A. D. 1893, "Relative to a Forestry Commission, &c.," provides among other things, "the said Commissioner shall also ascertain what wild lands, if any, now belong to the Commonwealth, their extent, character and location and report the same together with a statement of what part or parts of such lands would be suitable for a State Forest Reserve, &c."

Will you please furnish this Commission with a transcript of the

records, maps, description, &c., on file in your department, that will give us the information necessary to locate the wild lands belonging to the Commonwealth, and oblige,

Yours respectfully,

(Signed)

A. HARVEY TYSON,
Eng'r Member Forestry Com.

To Col. Thos. J. Stewart,
Secretary of Internal Affairs, Harrisburg, Pa.

Harrisburg, Pa., August 4, 1893.

A. Harvey Tyson, Esq., Member of the Pennsylvania Forestry Commission, Harrisburg, Pa.:

Dear Sir:—We acknowledge receipt of your letter of yesterday in which you ask us to furnish your commission with a transcript of the records, maps, descriptions, etc., on file in this department that will give you the necessary information to locate the wild lands belonging to the Commonwealth. In reply to this inquiry we beg to say that this information cannot be given, for the reason that no such records, maps, descriptions, etc., are on file here. The manner of granting titles by the Proprietaries in the early days of the Colony and subsequently by the State of Pennsylvania was such as to render it impossible for any one to tell from the surveys returned to this department whether or not there is any vacant or unappropriated land in the Commonwealth. This question can be determined only by the lines marked upon the grounds which show the relative position of each tract of land with reference to its adjoiners. You will understand that in this disposition of lands by the Government of the United States a different plan was pursued from that in vogue in Pennsylvania. The United States Government, so far as we know, has caused the lands to be surveyed and plotted, maps of which are kept in the land office at Washington, and whenever tracts have been sold or conveyed a record is made upon these maps in such a way that the officers of the land office can tell what portions of the land so surveyed have been disposed of. In Pennsylvania the lands were disposed of in part by virtue of pre-emption laws through which the buyer gained a right to the warrant, survey and patent. In many instances he established his own lines long before they were surveyed by authority of the Secretary of the Land Office or the Surveyor General. In other instances persons would apply to the State for warrants to survey land and were at liberty to locate their rights wherever they saw fit to do so. In some cases warrants were taken out which were designated as descriptive warrants and

were made to adjoin tracts of land that had been previously surveyed. Sometimes strips of unappropriated land were left between tracts, and frequently junior warrants were made to interfere with older rights, but the draft of the survey when returned rarely showed any such interference.

This practice, as may be seen, resulted in the unappropriated lands of the State being taken up in a haphazard and irregular way, and makes it impossible for us to tell at this time whether or not there is any vacant or unappropriated land in the Commonwealth. Doubtless there are in the mountain regions of the State, and possibly in some of the settled portions, strips of vacant land, but their location can be determined only by a knowledge of the location of the lines which mark the boundaries of the tracts which were surveyed fifty, seventy-five or one hundred years ago. This statement, perhaps, will be emphasized to some extent when we say that in many instances it is impossible to take the surveys descriptive of adjoining tracts and make a connected draft of them, for the reason that there are in many cases no points of coincidence, the courses, distances and corners called for in one tract failing to agree with those called for in the adjoining tract. In such cases only the surveyors who trace the original lines can determine whether there is vacant land between such tracts.

This department would gladly furnish you with any information on the subject of your inquiry, if it were able to do so, but for the reasons given we think you will see that the records here will not afford such information.

Very truly yours,

ISAAC B. BROWN,

Deputy Secretary,

For THOMAS J. STEWART,

Secy. of Int. Affairs.

Forestry Commission of Pennsylvania,
Harrisburg, May 1, 1894.

To the County Commissioners:

.....

..... County, Penna.

Gentlemen: We respectfully hand you herewith a circular issued by the Governor of the Commonwealth, bespeaking the helpful cooperation of citizens in the work of the Forestry Commission. We enclose also a portion of the act creating the Forestry Commission relative to wild lands, if any exist, which now belong to the Commonwealth.

After reading these papers we would ask your response to the following inquiries:

1. Are there any wild lands in your county now belonging to the Commonwealth?
2. Can you either directly or through agencies under your control, mark on a map to be furnished by this commission the boundaries and the acreage of such lands?.....
3. If so, and provided you are willing to undertake the work, what would you estimate to be the necessary charge for that service?
4. What time would it require?.....
5. If unable, directly or indirectly, to obtain the information sought, it would oblige us very much if you will kindly suggest how, in your judgment, the commission should proceed to obtain it with the best likelihood of success?

In order to comply with the mandate of the General Assembly, we distribute this circular throughout the Commonwealth, and will thank the commissioners of the older counties, where the public lands have been parcelled out long ago, to answer our first question at least.

Very respectfully,

J. T. ROTHROCK,
WM. F. SHUNK,
Forestry Commissioners.

Summary of replies received to foregoing circular No. 9, sent to county commissioners May, 1894, asking if there were any wild lands belonging to the Commonwealth, whether the boundaries and acreage of such lands could be marked on a map furnished by the commissioners; what the cost would be and what time would be required:

Adams, none.
Allegheny, none.
Armstrong, none.
Beaver, no answer received.
Bedford, none.
Berks, none.
Blair, no answer received.
Bradford, none.
Bucks, no answer received.
Butler, none.
Cambria, none known to exist.
Cameron, no answer received.

Carbon, no answer received.
Centre, no answer received.
Chester, none known to exist.
Clarion, none.
Clearfield, no answer received.
Clinton, none.
Columbia, no answer received.
Crawford, no answer received.
Cumberland, none.
Dauphin, no answer received.
Delaware, no answer received.
Elk, none known to exist.
Erie, no answer received.
Fayette, no answer received.
Forest, none.
Franklin, none known to exist.
Fulton, yes, boundaries could be ascertained in two months for \$75 or \$100.
Greene, none.
Huntingdon, none.
Indiana, none.
Jefferson, none.
Juniata, possibly a few small tracts not worth looking up.
Lackawanna, none.
Lancaster, no answer received.
Lawrence, none.
Lebanon, no answer received.
Lehigh, none.
Luzerne, no answer received.
Lycoming, a few small pieces of a few acres each, but worth very little.
McKean, none.
Mercer, none.
Mifflin, a few small pieces, in all not more than 400 acres.
Monroe, none known to exist, but there may be some; could find out for \$20.
Montgomery, none.
Montour, none.
Northampton, none.
Northumberland, none.
Perry, none.
Philadelphia, none.
Pike, there may be some, but probably very little.
Potter, none.
Schuylkill, no answer received.

Snyder, none known to exist.

Somerset, no answer received.

Sullivan, none.

Susquehanna, none known to exist.

Tioga, no answer received.

Union, no answer received.

Venango, none.

Warren, none known to exist.

Washington, none.

Wayne, none known to exist.

Westmoreland, none.

Wyoming, none.

York, none.

Twenty counties did not answer. Forty-one counties said there was none. Fulton, Juniata, Lycoming and Mifflin say there are a few small tracts, but worth very little. Monroe and Pike say there may be some, but probably very little.

CHAPTER VI.

TIME AND FIRE AS ELEMENTS IN THE FORESTRY PROBLEM.

About 1878 the annual output of white pine from the Pine Creek region was not far from 100,000,000 feet a year. Kettle Creek, I am informed, once ran out as much, or nearly as much as Pine Creek.

I use the above paragraph, which I have not verified, but which I have no reason to doubt, as it was given to me by those who have long been familiar with the regions in question, because I wish to point a principle, or rather the absence of a principle, in our forest policy.

We regard our cereal grains as a crop for two reasons, first, because they are valuable to us, and second, because they mature so speedily as to return a prompt reward for our labor of sowing and harvesting. Lumber-producing trees differ in no respect from our cereals as a crop, except that they require a longer period to mature, and we have not had the care of producing them.

We may emphasize the value of the forest crop by saying, that in this State it far exceeds, financially, that of our cereals. The only reason why we have not undertaken to restore our forests is not because they are not necessary to our prosperity, but because we have so long been reaping this harvest of trees without planting that we instinctively act on the supposition that we always can do so. Now the fact is that the end of some of our most valuable trees is in sight. I do not mean to say that we shall have no white pine, or hemlock, or black walnut, but I do assert that inside of the next fifteen years the State will have been so far denuded of these and other valuable trees, that the Commonwealth will suffer most seriously because industries that have contributed enormous sums of money to our people will have practically vanished from the want of material to operate upon, and because also, there is nothing to take their place. What makes the matter worse is the fact that we have not yet taken one direct, practical step toward restoration of the material upon which this prosperity depends.

To make this more clear we will appeal to Vol. IX of the Tenth Census, where, on page 487, we find that the total value of the lumber products of Pennsylvania was in the year ending May 30, 1880, not less than \$22,457,359. This, be it remembered, was simply as lumber, and not after being further manufactured. Pennsylvania then stood second on the list of lumber-producing states, being only

exceeded by Michigan, whose product aggregated at the same time \$52,449,928. This estimate for Pennsylvania does not include the money distributed through the tanning industry, which now aggregates not far from twelve million dollars annually.

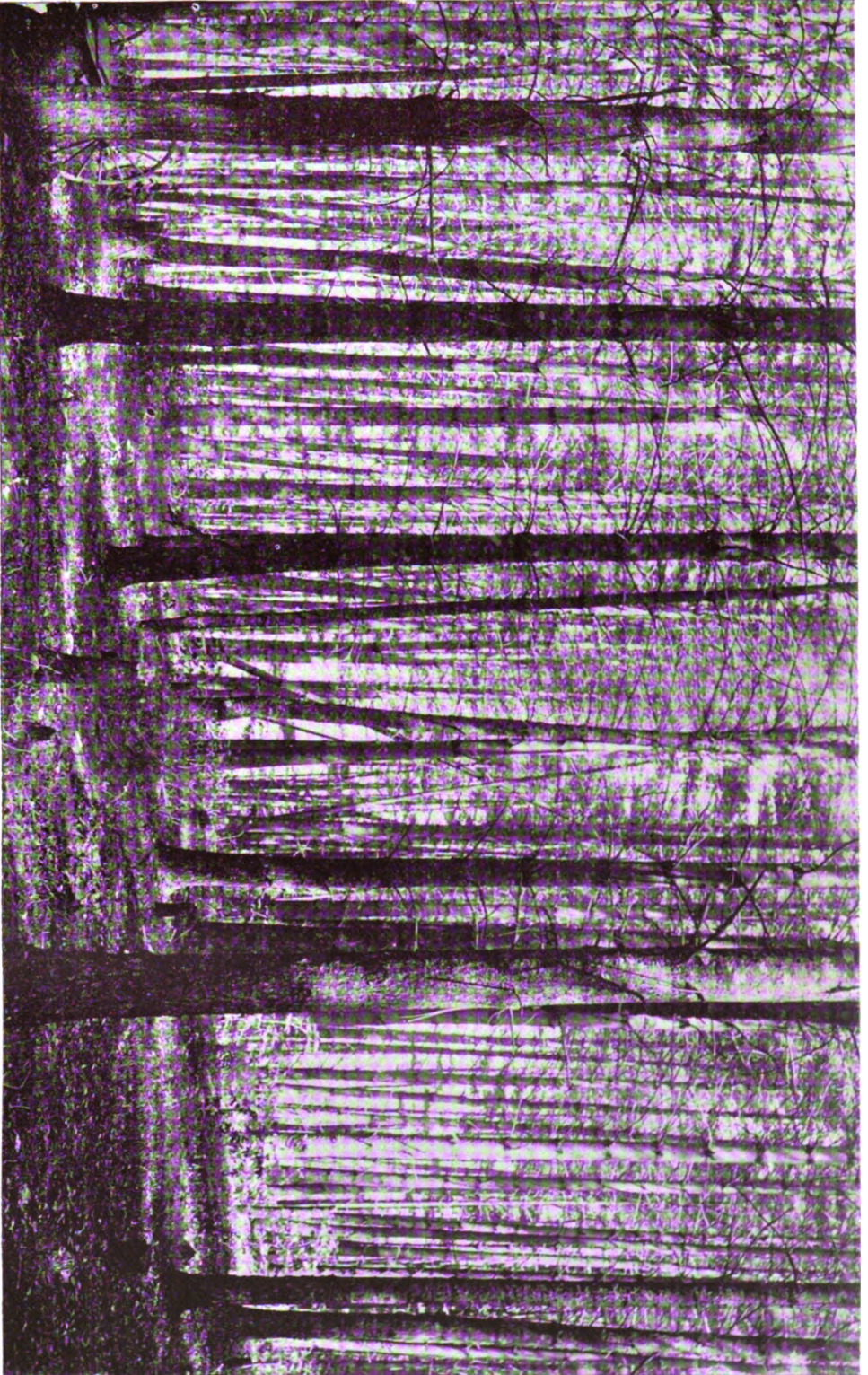
Add to this the product of the wood acid factories and the establishments for the manufacture of wood pulp, the statistics of which I have not been able to obtain. There is material in this Commonwealth for the two industries last named for a score of years, at least, but the lumbering industries and the tanning operations indicated above are practically doomed, as things are now, to a speedier extinction.

At the present time there are not more than half a dozen good sized bodies of white pine left standing within our limits. There is no disguising the fact then, that our Commonwealth is soon to experience the serious loss resulting from extinction, in great part, of these industries. This naturally leads to the consideration of what might have been. As a standard of comparison, we will take white pine because it has been our most valuable timber crop, and also because it will grow on soil of poor quality in a large portion of the State.

The following careful statement was made by Mr. Roth and published in *Forest Leaves*, October, 1894, page 166:

"In the case of young white pines, such as are grown quite extensively in New England and frequently furnish the material for calculations of this kind, only small dimensions need be considered. In some good groves 40 years old, the trees 200 to 250 per acre have attained a height of about 50 feet, and an average diameter of 10 to 13 inches. At best, such trees, if cut into lumber in the ordinary manner will hardly make 100 feet of material and that mostly knotty; yet even so an acre may readily yield 20,000 feet, which is 500 feet per acre for each year of growth."

It may be well to make special application of this to the Commonwealth. Plate 11 shows a volunteer crop of white pine now growing in "The Barrens" of Centre county. Thirty-five years ago the soil on which it stands was practically a waste. The trees average about fifteen inches across the stump. It would be a fair estimate to say that they stand from two to three hundred to the acre, or did before their size invited the axe. If even devoted to the manufacture of pulp at this stage the sum realized on the sale would be an enormous interest on the value of such land. It should, however, be remarked here that it would be the poorest forest policy to cut such trees just when they are making their most rapid growth. If we assume that their average annual growth in diameter was a ring of one-fifth of an inch wide, it will be readily understood that this means a much larger quantity of wood around a stem of fifteen inches diameter than around one of five or ten inches in thickness.



(Plate II. See page 60.)

Volunteer Crop of White Pine, Thirty-five Years Old. Centre County.



(Plate 12. See page 61.)

What We Might Have—White Pine. What We Do Have—Underbrush.
Clearfield County.



Or take another species of tree, the chestnut. It, too, grows naturally over almost the entire State, or certainly would if planted. It will thrive on soils of the most diverse character, and besides the ordinary well-known uses to which it has long been applied, it will probably be in increasing demand for shingles, and certainly so for the production of tannin to supplement the decreasing supply of hemlock. Thirty years would be an ample period to produce timber large enough for either of these purposes. Then when the first crop was cut there would come from the stump another growth, probably three times as large as the first, and in about the same time. Grant that the trees must be started from the seed, or by the planting of young trees, even then there is no difficulty in the problem. In a large proportion of cases, however, after the first or original forest growth is removed the chestnut springs up spontaneously.

I admit that exact statistics are meagre, but think it can be proved that in half a century this State should have on grounds, otherwise waste, a timber crop worth a billion and a half of dollars. It is well to inquire why we have no indications of a crop of such value on lands cleared long ago. There are two reasons, first, because we have taken no pains to start it, and, second, because we have wholly failed to offer any protection against forest fires. Planting alone goes for nothing in the absence of protection. If we could have this crop on otherwise waste lands, and do not, it is well to ask what the potential loss (not the actual loss) is to the Commonwealth for each fire or each series of fires that devastate the timber producing areas. Clearly it is one-fiftieth of \$1,500,000,000, or \$30,000,000. I have been reminded that I have in this made no estimate for interest on capital during the half century involved. Where is the capital? The land upon which the timber would grow has practically no value in the market, because it will produce no other crop. It is of the class of which one and a half million acres have within the past year been sold for taxes in our own State. The labor given to the crop is practically nothing in most instances. It represents an unearned increment which we should have the common wisdom and common gratitude to protect. (See Plates 12, 13, 14 and 15).

It will appear incredible to the majority of our citizens that one firm in this State has lost one hundred and fifty million feet of timber by the forest fires of recent years; and that another has had one hundred and twenty-five thousand acres devastated during the past season. It is still more incredible that in spite of all this, there should be upon our statute books no efficient protection against these constantly recurring conflagrations.

This would appear to be the place to call attention to the fact that taxes are paid for protection to property as well as to person, and that there is no good reason why forest property should receive less

than any other kind of real estate. Even public opinion, while it denounces the burner of a house or a barn, or even a fence, as an incendiary, will carefully guard the epithet which it applies to the one who wilfully or negligently fires a forest.

Owing to the absence of any effective system by which statistics of forest fires could be gathered we have found this branch of our work very unsatisfactory. It will be seen, however, that an effort has been made to do what we could in the time at our disposal. It is fair to say that the following table gives a very inadequate idea of the actual loss by forest fire throughout the State.

Of all the causes which destroy property by fire, insurance companies have learned to place burning forests third or fourth in the list.

FOREST FIRES.

In December, 1894, letters of inquiry were sent to gentlemen in the different counties, asking for information in regard to the forest fires which have been so destructive in some parts of the State.

In order to obtain clear and definite statements in this matter, the following questions were submitted to them for consideration and careful reply:

1. Over how large an area did forest fires burn in your county in 1894?

2. Over how large an area did they burn in the years 1891, 1892 and 1893?

3. What was the value in money of the property destroyed in any one, or in all the years indicated?

4. Specify whether the damage was to:

Mature standing timber,
Promising young second growth,
Prepared lumber,
Bark in piles,

and what it actually cost in work or money to stop the fires.

5. What measures can you suggest towards preventing and arresting these periodical fires?

Many of these gentlemen gave very satisfactory answers, while others with less opportunities for observation or information, furnished but little.

The material received has been analyzed and tabulated as follows:

Forest Fires.

COUNTY.	AREA BURNED.	KIND OF DAMAGE.	VALUE BURNED.	REMEDIES PROPOSED.	AUTHORITY.
Bedford,	1894, 1893, 1892, very large.	To standing timber, to young second growth, to stop the fires, cost a great deal of time and money.	Very great.	Require supervisors and constables by oath to prosecute and impose heavy penalties.	D. M. Wonders, New Paris.
Cambria,	1894, none. 1891, fifty square miles.	Seven or eight steam saw mills, thousands of feet of manufactured lumber, millions of standing timber, railroads, bark and paper wood, mature timber and young second growth. Cost \$5,000 to put out the fires.	Three hundred thousand dollars. Loss in twenty-five years, \$2,000,000.	A fire marshal to each 1,000 square miles, with a deputy in each township, each with a fixed salary.	John Mc'ormick, Wilmore.
Centre,	Fifteen thousand to 25,000 acres yearly.	Mature timber, young second growth.	. . . . .	Make fire roads. State appoint fire wardens.	Geo. R. Boak, Pine Glen.
Centre, . . . . .	. . . . .	. . . . .	. . . . .	Railroad appoint fire guards. Punish those who set fires. State buy waste lands to be protected by a State police.	John Hamilton, State College.
Centre,	1894, twenty square miles. 1892, the same.	Mostly young timber which has no chance to grow into money value.	Worth several thousand dollars. Cost of putting out the fires as much more.	Stringent laws to punish offenders and some one in each township whose business would be to enforce the law.	Samuel Brugger, Fleming.
Chester,	1894, 500 acres. 1893, none. 1892, none.	Cost \$200 to keep the fire from spreading.	. . . . .	Railroad companies keep their spark arresters in order. Prohibit burning over land and punish those who start fires.	Wm. M. Potts, Wybrooke.
Clearfield, . . . . .	. . . . .	. . . . .	1894, \$100,000; 1891, 1892, 1893, \$200,000.	. . . . .	J. Blair Reed, Clearfield.
Clinton,	1894, 200 acres. 1893, the same.	Bark in piles, mature timber, second growth. Cost \$400 to stop the fires.	Forty thousand or 50,000 dollars.	State appoint a property holder to watch, with authority to arrest. District attorney should prosecute.	H. T. Hale, Look Haven.

Forest Fires—Continued.

COUNTY.	AREA BURNED.	KIND OF DAMAGE.	VALUE BURNED.	REMEDIES PROPOSED.	AUTHORITY.
Columbia. . . . .	. . . . .	. . . . .	. . . . .	Ascertain and convict malicious persons. Punish with fines and imprisonment.	Josiah Heacock, Millville.
Elk.	1894, 20,000 acres.	Standing timber, young second growth.	Loss counted by thousands.	State should take vigorous action. . .	Chas. Luhr, St. Marys.
Fulton.	1894, 12,000 acres. 1893, 12,000 acres. . . . .	. . . . .	. . . . .	. . . . .	S. P. Wishart, Well's Tannery.
Lycoming.	1894, 1,400 acres. 1893, 500 acres. 1892, 800 acres.	Young second growth, 800 saw logs, 1,100 cords bark, 1,500,000 feet hemlock and standing hardwood. Young second growth, board fences, etc.	\$2,100 3,800 1,800	Keep forestry patrol in each township during the spring months. Have fire lines each side of properties and punish all guilty parties.	Abram Meyer, Co-gan House.
Luzerne.	1894, 2,000 acres. 1893, 500 acres. There were other very serious and destructive fires.	Young growth of chestnut trees. Cost \$3,000 to keep the fires down. Fires also caused by the huckleberry pickers.	Gen. Oliver only gives his own area burnt over.	The railroad should burn 150 feet each side the tracks each fall.	Paul A. Oliver, Oliver's Mills.
Mifflin.	1894, thousands of acres. the same in previous years.	Young growing timber, mature timber, prepared lumber, bark in piles.	Loss was very great.	A law offering a reward for the arrest and conviction of guilty parties, with a severe penalty attached.	J. S. Taylor, Reedsville.
Mifflin. . . . .	. . . . .	Have no information at command.	. . . . .	A law appointing trusty watchmen. Divide the mountains into districts with a watchman to each.	Jos. W. Kyle, Millroy.
Wm.	Destruction by fire is very great. 1,000 acres have been cut off in five years.	Most damage is done in spring and fall by fire to the second growth. Chestnut sprouts grow rapidly, and in twenty years, the fire was kept, would be worth \$100 a year or \$2,000 for that.	In the burning of bark, wood and saw timber the loss is very heavy.	The State should take charge on account of the fresh water supply. Five hundred dollars reward should be offered for the conviction of guilty persons in any year. Township supervisors and a big fire. Township supervisors should have authority to employ and pay men to surround and put out fires.	R. J. McNitt, Millroy.



(Plate 13. See page 61.)

Burned Timber. Six Mile Run, Centre County.

Monroe.	1894, 24,880 acres. 1894, burned. Set on fire by the burning of the fire runs over the same ground every two or three years.	Mainly to second growth. Forty-two years ago spruce trees have been cut and shipped to Philadelphia and New York. Trees thirty or forty feet high are cut down just for the tops, leaving the remainder on the ground to rot or feed fires.	During last twenty years several million dollars have been lost in this and in Carbon county.	Best way is to have paid detectives to patrol portions of the county with dogs and traps, and to report to the station and quietly give information of trespassers.	W. C. Edelman. Easton.
Puter.	1894, 2,400 acres. 1891, 1892, 1893 the same as 1894.	In 1891, 15,000 cords of bark, 6,000,000 feet of logs, 10,000 acres of timber. Mature timber, young second growth, some lives lost.	Five hundred thousand dollars in money and the labor and time of thousands of men.	A law empowering the State to employ a force sufficient to prevent the setting and spread of fire.	Wm. A. Crosby. Coudersport.
Sebuykill.	1894, 4,000 acres were burnt in Tremont and Fraley townships alone. In the county at least 50,000 acres were burnt over.	The damage to the young growth of oak and chestnut, which, if the fires are kept out, would, in fifteen or twenty years, be worth thirty dollars per acre.	The indirect loss of the young timber must amount to \$1,500,000.	Commissioners appointed fire wardens in the spring of 1894 and there were more fires than ever before. Can't suggest any other remedy if the officials do not do their duty.	C. D. Arters, Tremont.
Union.	1894, 1893, 1892, 1891, 90,000 acres.	Mature timber, young second growth, saw-logs, bark, posts, rails, cord-wood.	Two thousand to 4,000 dollars annually.	Make those causing fires accountable. Increase largely penalties for incendiary fires.	Calvin M. Hayes, Hartleton.
Union.	1894, 5,000 to 10,000 acres. 1893, same amount burnt over.	Young white pine, young growth chestnut.	Hundreds of thousands of dollars.	Station men at proper places to watch and stamp out the fires.	C. Sheckler, Milfordsburg.
Wayne.	1894, little damage done; a few hundred acres.	Fifty to seventy-five cords of acid wood, some small timber. \$100 or \$200 worth of fences.	Three hundred to 400 dollars.	Starting fires should be made a misdemeanor punishable by fines or imprisonment.	N. F. Underwood, Lake Como.
Wyoming.	1894, 2,400 acres.	Saw-logs worth Mature timber worth Second growth worth Putting out fires cost	\$1,000 700 200 550 \$2,450	Make fire roads. Station men with buckets to watch the fires and kill them.	E. D. Robinson, Yorkston.

In going from Cross Forks, Clinton county, across to Renovo, by way of Tamarack swamp, I passed extensive areas in which white pine was once the prevailing tree. Here and there a solitary specimen remained. It was too small to cut when the rest were felled and by some Providential accident had escaped the fires which destroyed its fellows. It, however, showed what the possibilities were, and was a convincing argument to prove that a large part of that region and of the valley of Kettle Creek might have been to-day realizing from a second crop. Instead of which there is produced nothing of value.

It is an instance where the present generation is suffering from the neglect of those who have gone before, and it suggests the inquiry whether or not those who come after us shall suffer by ours.

It required half a century to mature an average crop of timber. Can it ever be done sooner than by commencing now?

Timber is to remain an essential element of our State's prosperity, because faster than substitutes are discovered new uses are found for it; and there can be no excuse for delay in entering actively upon the only policy that promises restoration of our crippled lumbering industries.

ACTS, ORDERS AND REGULATIONS RESPECTING CROWN LANDS IN ONTARIO.

AN ACT

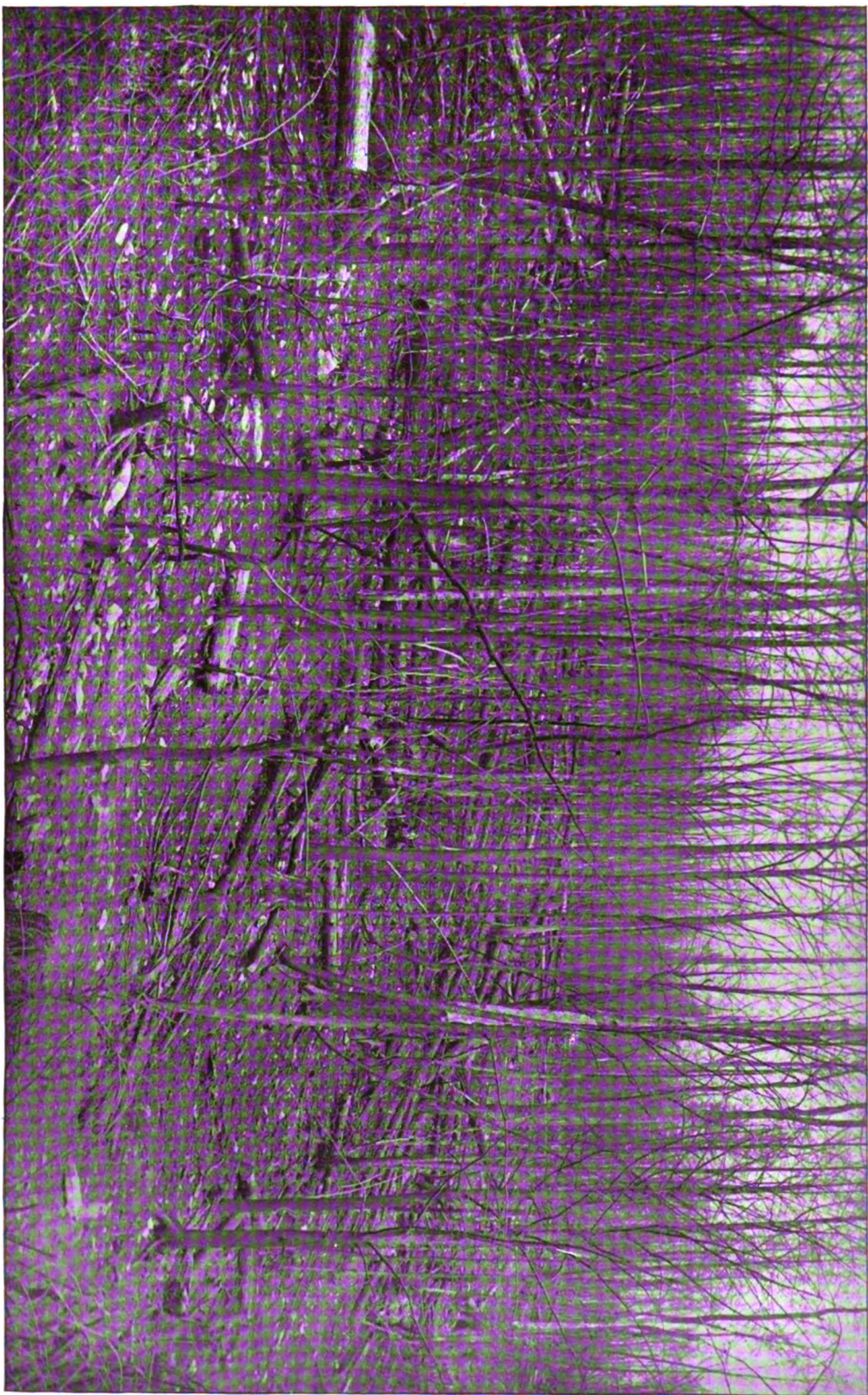
To preserve the forests from destruction by fire.

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. The Lieutenant Governor, may, by proclamation to be made by him from time to time, issued by and with the advice and consent of the Executive Council, declare any portion or part of the Province of Ontario to be a fire district.

2. Every proclamation under this act shall be published in the "Ontario Gazette;" and such portion or part of the province as is mentioned and declared to be a fire district in and by the said proclamation, shall, from and after the said publication, become a fire district within the meaning and for the purposes of this act.

3. Every portion or part of the Province mentioned in the proclamation shall cease to be a fire district upon the revocation by the Lieutenant Governor in Council of the proclamation by which it was created.



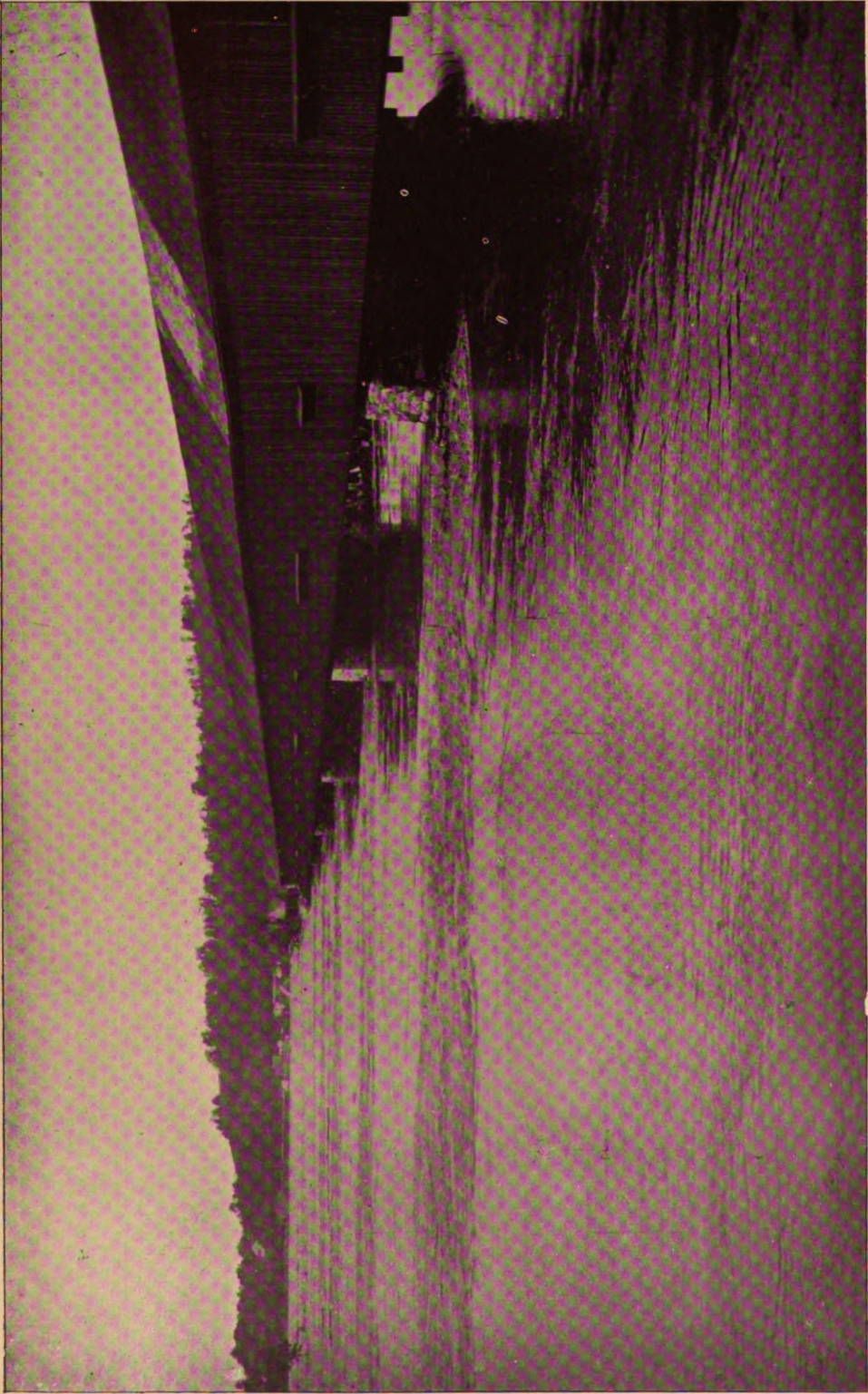
(Plate 14. See page 61.)

Fire After a Lumbering Operation. Anderson's Creek, Clearfield County.



(Plate 15. See page 61.)

View in Burned Region of Clearfield County.



(Plate 16. See page 76.)
High Water, 1889. Susquehanna at Harrisburg.

4. It shall not be lawful for any person to set out, or cause to be set out or started, any fire in or near the woods within any fire district between the 1st day of April and the 1st day of November in any year except for the purpose of clearing land, cooking, obtaining warmth, or for some industrial purpose; and in cases of starting fires for any of the above purposes, the obligations and precautions imposed by the following section shall be observed.

5. Every person who shall, between the 1st day of April and the 1st day of November, make or start a fire within a fire district for the purpose of clearing land, shall exercise and observe every reasonable care and precaution in the making and starting of such fire, and in the managing of and caring for the same after it has been made and started, in order to prevent the fire from spreading and burning up the timber and forests surrounding the place where it has been so made and started.

6. Every person who shall, between the 1st day of April and the 1st day of November, make or start within such a district a fire in the forest, or at a distance of less than half a mile therefrom, or upon any island, for cooking, obtaining warmth or for any industrial purpose, shall:

A. Select a locality in the neighborhood in which there is the smallest quantity of vegetable matter, dead wood, branches, brushwood, dry leaves or resinous trees.

B. Clear all the place in which he is about to light the fire by removing all vegetable matter, dead trees, branches, brushwood and dry leaves from the soil within a radius of ten feet from the fire.

C. Exercise and observe every reasonable care and precaution to prevent such fire from spreading, and carefully extinguish the same before quitting the place.

7. Any person who shall throw or drop any burning match, ashes of a pipe, lighted cigar or any other burning substance, or who shall discharge any firearm within such fire district, shall be subject to the pains and penalties imposed by this act if he neglect completely to extinguish before leaving the spot the fire of such match, ashes of a pipe, cigar, wadding of the firearm or other burning substance.

8. Every person in charge of any drive of timber, survey or exploring party, or of any other party requiring campfires for cooking or other purposes, within a fire district, shall provide himself with a copy of this act and shall call his men together and cause the act to be read in their hearing, and explained to them at least once in each week during the continuance of such work or service.

9. All locomotive engines used on any railway which passes through any fire district, shall, by the company using the same, be provided with and have in use all the most approved and efficient

means used to prevent the escape of fire from the furnace or ash-pan of such engines, and the smoke stack of each locomotive engine so used shall be provided with a bonnet or screen of iron or steel wire netting, the size of the wire used in making a netting not to be not less than number nineteen of the Birmingham wire gauge, or three sixty-fourths parts of an inch in diameter, and shall contain in each inch square at least eleven wires each way at right angles to each other, that is in all twenty-two wires to the inch square.

10. It shall be the duty of every engine driver in charge of a locomotive engine passing over a railway within the limit of any fire district, to see that all such appliances as are above mentioned are properly used and applied, so as to prevent the unnecessary escape of fire from any such engine as far as it is reasonably possible to do so.

11. Whosoever lawfully neglects or refuses to comply with the requirements of this act in any manner whatsoever, shall be liable, upon a conviction before any justice of the peace, to a penalty not exceeding \$50 over and above the costs of prosecution, and in default of payment of such fine and costs the offender shall be imprisoned in the common gaol for a period not exceeding three months; and any railway company permitting a locomotive engine to run in violation of the provisions of section nine of this act, shall be liable to a penalty of \$100 for each offense, to be recovered with costs in any court of competent jurisdiction.

12. Every action for contravention of this act shall be commenced within three months immediately following such contravention.

13. All fines and penalties imposed and collected under this act shall be paid one-half to the prosecutor and the other half to Her Majesty for the public use of the Province.

14. It shall be the special duty of every Crown land agent, woods and forest agent, free grant agent and bush ranger to enforce the provisions and requirements of this act, and in all cases coming within the knowledge of any such agent or bush ranger, to prosecute every person guilty of a breach of any of the provisions and requirements of the same.

15. Nothing in this act contained shall be held to limit or interfere with the right of any party to bring and maintain a civil action for damages occasioned by fire, and such right shall remain and exist as though this act had not been passed.

ABSTRACT OF MAINE STATUTE.

An act to create a forest commission and for the protection of forests.

Approved—March 25, 1891 (page 90, chapter 100).

Section 1. Land agent made forest commissioner.

Sec. 2. Duties: To collect statistics relating to forests and connected interests; to ascertain extent of destruction by fire and wasteful cutting, and to ascertain the diminution of the wooded lands on watersheds, and its effect on the water power and climate.

Report to be made annually together with his suggestions.

Sec. 3. Select men of the towns to be ex-officio, fire wardens and to divide each town into three districts.

Duty of fire warden of the district where fire discovered to take such measures as necessary for its extinction; and to have authority to call upon any person within his district for assistance, they to receive not more than fifteen cents per hour as selectmen may determine, same to be paid by town. But no town to be held to pay in any one year an amount for that purpose greater than two per cent. upon its valuation for taxing purposes.

Penalty for refusal so to assist, \$10.00.

Sec. 4. County commissioners to appoint fire wardens for all "unorganized places." Same compensation to persons assisting as above, but to be paid one-half by the county and one-half by owners of land on which the fire occurs.

Sec. 5. Penalty for not extinguishing camp or cooking fires, built in or adjoining any woods, not over \$100 fine or imprisonment not over one month or both.

Sec. 6. Notice of such penalty to be posted by selectmen in a conspicuous place at the side of every highway as they may deem proper, and at suitable distances alongside the rivers and lakes of the State frequented by camping parties, tourists, hunters and fishermen. Owners of woodlots also to be furnished with such notices at their expense on application therefor.

Sec. 7. Hunters in wood lands to use non-combustible gunwads.

Sec. 8. Inquiry to be made by municipal officers and county commissioners into origin of fires, and to prosecute offenders where discovered.

Sec. 9. Selectmen of towns where a fire of more than one acre in extent has occurred and county commissioners where of more than two acres in unincorporated places, within a year to report to forest commissioner, their extent, with probable amount of property de-

stroyed, value of timber and amount of cordwood, logs, bark or other forest products, fencing, bridges and buildings destroyed. Also report cause if ascertainable and measures employed and found most effective in checking the fires.

Blanks to be furnished by forest commissioner for such reports.

Sec. 10. Railroad companies through forest lands annually to cut and remove all inflammable material from their right of way.

Sec. 11. All such locomotives to have approved and efficient spark-arresters.

Sec. 12. Railroad employes not to deposit live coals on track in such regions, and where they notice fences or woodlands along the railroad burning, to report same at next telegraphing station.

Sec. 13. For all damages to forest growth by any employe in construction of railroad company owning such road to principally liable to person injured.

During such construction, abstracts of forest laws to be posted every 200 feet along line of railroad through forest. Penalty for employes failing to extinguish fires set by them, fine of not over \$500 or imprisonment not over 60 days or both; and persons in charge of such men to see that those provisions are complied with, under liability to same penalty.

Sec. 14. Any railroad company violating the requirements of this act, to be liable to fine of \$100 for each offense.

Sec. 15. The forest commissioner shall take such measures as the state superintendent of common schools and the president of the state college of agriculture and the mechanic arts may approve for awakening an interest in behalf of forestry in the public schools, academies and colleges of the state and of imparting some degree of elementary instruction upon the subject therein.

Sec. 16. Commissioner to issue free circulars of advice for care of wood lands.

Sec. 17. Copies of this act and all others relating to forest fires to be distributed to selectmen, who shall post them in schools, saw mills, logging camps, etc., and to owners of such lands on application. Five dollars fine for destroying or tearing down such notices.

Sec. 18. Inconsistent acts repealed.

BILL REPORTED BY PENNSYLVANIA FORESTRY COMMISSION, JANUARY, 1895.

House bill No. 30, "An act providing for the preservation of forests of the Commonwealth and to this end enlarging the powers and duties of the Forestry Commission, designating fire wardens and prescribing their duties, regulating the prevention and extinguishment of forest fires and providing for the punishment of persons who set fire to or endanger forests.

Section 1. That the Forestry Commission shall have authority, and it shall be the duty of said Forestry Commission under this act:

(a) To make a report to the General Assembly, through the State Board of Agriculture, at each regular session, giving an account of forest fires, their causes, extent, values destroyed, methods recommended for preventing them, the cost of extinguishing them and such other information and suggestions concerning their charge as the said Commission shall judge to be important to the welfare of the Commonwealth.

(b) To prepare at the public charge and freely distribute to the fire wardens, and to citizens interested in protecting the forests, who shall apply for them, warning placards containing brief summaries from the provisions of this act for the information of lumbermen, railroad employes, hunters, fishermen, tourists and others who might violate the law unwittingly.

(c) To prepare at the public charge and to distribute copies of this act, that it may be known throughout the Commonwealth by whomsoever it may concern.

(d) To take measures at the public charge for the free diffusion of knowledge concerning forestry in the form of lectures and essays commending the subject to public attention.

(e) To prepare at the public charge for the guidance of fire wardens a code of rules and regulations, having reference to this act, utilizing the experience of other states and embodying from time to time the results of our own experience.

(f) To appoint special fire wardens with the approval of the Governor of the Commonwealth in remote and thinly peopled forest districts where prompt action is necessary to prevent destructive conflagrations, providing that such special fire wardens shall be resident citizens of the said districts respectively and shall be removable for cause by the Forestry Commission. They shall have the same powers, duties and emoluments as the district fire-wardens. The compensation of special fire wardens and of the persons employed by them under the provisions of this act shall be paid by the Commonwealth in accordance with such rules as shall be prescribed by the Forestry Commission with the approval and concurrence of the Auditor General of the Commonwealth.

Sec. 2. That the supervisors of roads of the respective townships shall, by virtue of their office, be district fire wardens within the limits of their districts and in cases of emergency shall serve as such beyond the said limits. They shall have authority and it shall be their duty as fire wardens:

(a) To go to the ground at once in case of a forest fire within the limits of their respective districts and take all necessary measures for its control and extinguishment.

(b) To call upon any persons within their townships or the vicinity thereof to assist them in that service.

(c) To co-operate with the fire wardens of any adjoining district and in the absence of such fire wardens to direct the work of control and extinguishment of forest fires in any such district.

(d) To attend on the ground when notified by any person proposing to fire brush or other combustible matter on or near forest land and to supervise or, if necessary, to postpone such firing in order to prevent forest fires.

(e) To arrest without warrant every person found violating any provision of law relating to forest fires and to forthwith take the offender before a magistrate and make complaint against such person.

(f) To inquire into the cause of every forest fire within their several districts and if any such fire be traceable to the negligence or wilfulness of any person, company, society or corporation, to make complaint before a magistrate against such person, company, society or corporation.

(g) To post and keep posted warning placards prepared by the Forestry Commission in localities where fires are likely to occur and to carry into effect such rules and regulations as may be prescribed with the approval of the Governor of the Commonwealth, by the said Forestry Commission conformably to the provisions and in furtherance of the object of this act.

(h) To open and to keep open fire lanes not less than two rods wide and where authorized by the Forestry Commission, as barriers against fire, provided that the said lanes need not be graded as public highways, nor shall they be opened in any case without the previous consent in writing of the landowners granting free right of way and releasing all claim for compensation therefor.

(i) To make two reports annually in duplicate at dates to be fixed by the Forestry Commission, giving the statistics of forest fires, including the actual cost of suppressing them and other items, on the forms prescribed and furnished by the said Commission, one of the said duplicates to be sent to the district attorney of the proper county and the other to the Forestry Commission at Harrisburg.

(j) To wear exposed to view while on duty as fire wardens a dis-

inctive badge, which shall be furnished by the Forestry Commission, and shall be delivered by the respective fire wardens to their successors in office.

Sec. 3. It shall be the duty of the justice of the peace residing nearest the place of the origin of the forest fire to make prompt and strict inquiry into the origin of such fire, and whenever such fire is found to have been started wilfully or negligently by any person, company, society or corporation in violation of law to issue a warrant for the apprehension of the offender or offenders, and after a hearing, if sufficient cause be shown, bind him or them over to appear at the next court of quarter sessions for the proper county, or, in default of bail, commit him or them to answer as in other cases of misdemeanor, or he shall fine the offender or offenders if the fire was caused by his or their negligence.

Sec. 4. Any justice of the peace residing in any township where there shall be a forest fire shall, in the absence or in the case of the disability of the district fire warden, act as a substitute or appoint a substitute temporarily for him.

Sec. 5. Every person who shall neglect or refuse to assist in suppressing a forest fire when called on for such service by a fire warden shall be subject to a fine of five dollars for each offence, unless excused for good cause by the said fire warden or declared to be justly exempt after a hearing before a magistrate.

Sec. 6. Every person assisting to suppress a forest fire when called on for such service by a fire warden, shall be entitled to payment at a daily rate not greater than one dollar and fifty cents a day or proportionately for parts of a day.

Sec. 7. Every person, before firing brush or other combustible matter on or near forest land at hazard of injury to the property of others, shall notify the district fire warden of his attention, and shall not proceed with such firing, except by the written authority, or under the personal direction of said district fire warden or of his duly authorized substitute. Violation of this section shall be punished by a fine not exceeding fifty dollars.

Sec. 8. Every person, and every company, society or corporation shall be responsible for all injury to the property of others resulting from forest fires originated wilfully or negligently by themselves or their agents, and shall be liable in an action of trespass for the actual damages, direct and consequential, caused by such fire, and in case such fire originated negligently, shall also be subject to a fine not exceeding one hundred dollars.

Sec. 9. Every person who shall kindle a fire on or dangerously near to forest land, and leave it unquenched, or who shall be a party thereto, and every person who shall use other than incombustible wads for firearms, or who shall carry a naked torch, firebrand or other

exposed light in or dangerously near to forest land at hazard of accidental fire, shall be liable to a fine not exceeding fifty dollars for each offence.

Sec. 10. Every person who shall wilfully or heedlessly deface, destroy or remove any warning placard posted under the requirements of this act shall be liable to a fine not exceeding twenty-five dollars for each offence. Every person wearing a fire warden's badge without lawful warrant shall be liable to a fine of not more than fifty dollars.

Sec. 11. All fines imposed by this act shall be sued for before a justice of the peace in the name of the Commonwealth, as debts of a like amount are sued for, and the accused may be proceeded against by complaint and warrant of arrest or by summons as in civil actions, and in default of payment of any fine and costs imposed by a justice of the peace under this act, the defendant shall be committed to the county jail for one day for every dollar of fine and costs so imposed and unpaid. No fine imposed under this act shall be less than five dollars. One-half of all the fines imposed and collected under the provision of this act shall be paid to the informer in each case, and the other half to the supervisors of the township in which the offence was committed, for the use of such township.

Sec. 12. Supervisors acting as fire wardens shall be paid two dollars for each day of actual service in extinguishing forest fires or in supervising the brush fires, or others which are in dangerous proximity to other woodlands. The compensation of such fire wardens and of the persons employed by them under the provisions of this act shall be paid by the townships in which the forest fires shall occur, and such townships shall be reimbursed by the Commonwealth one-half the amount so paid, under such rules as shall be prescribed by the Forestry Commission, with the approval and concurrence of the Auditor General.

Sec. 13. The term forest in this act shall include not only woods in the ordinary sense, but also scrub brush, sprouts, briars and the like woody growths apt to feed or spread fire on wild land. The word district in this act shall mean such township subdivisions as are ordinarily made for convenience by the supervisors of roads.

Sec. 14. The prothonotary of every county within this Commonwealth shall, within fifteen days after the township elections in each year are returned into this office, make out, certify and deliver, under his hand and seal of office, to the Forestry Commission, a list of the names of the persons elected to the office of supervisor of roads, together with their postoffice addresses and the names of the townships within their respective counties for which they are respectively elected, and shall be allowed therefor the usual fees for equal or similar services, to be paid out of the county treasury.

The above bill, after having passed the House of Representatives, failed to pass the Senate.

CHAPTER VII.

RELATIONS OF FORESTS TO WATER SUPPLY.

There remains to be considered the most important problem—what are the relations of forest to climate, to floods and to low stages of water, and to our springs?

First, we may briefly dispose of the question as to whether or not the presence of large timbered areas increases the rainfall by answering thus—it is not proven that extensive forests in this region increase rainfall.

On the other hand, it may be asserted most positively that they do aid in the absorption of rain and melting snow, and that they do retard to a greater or less degree the delivery of water by floods in times of excessive rainfall, or when large bodies of snow are melted rapidly.

The effect of large forest areas upon climate is in many respects but poorly understood. There are, however, two principles which are beyond doubt and which must be accepted.

First, the presence of aqueous vapor in the atmosphere prevents the escape of the earth's heat by radiation, and in so far conduces to a mean or moderate climate. Conversely the absence of moisture in the air leads to escape of the earth's heat and thus leads to a climate of extreme temperatures. Second, trees, so long as they live and thrive, give off by evaporation and by transpiration to the air the water they have absorbed in the depths of the earth by the roots. This means supplying conditions toward producing a moderate climate, such as the growth and maturity of our crops depend upon. It may be asserted that observers have frequently failed to note any surplus of moisture over our forests, to which it must be replied that this is probably because it is rapidly diffused into the surrounding regions by wind currents. That it is given off, is beyond doubt, and whether localized in a limited area or spread over a larger district, its presence will be accounted for in terms of climate.

If this be true, that forests retain rainfall, then it would appear to follow that in proportion as the forests are removed the main streams which receive the tributaries from the smaller valleys, with their steeper hillsides, must be more subject to floods whose destructiveness will be measured by the volume and suddenness of the rainfall, or of the water derived from melting snow.

There were high stages of water in our rivers before the country was settled, and they doubtless will always continue in spite of any

precautions we may take. The practical question, however, is, are they on the increase in frequency and in violence? It is quite impossible to answer this question with absolute certainty now. There are, nevertheless, some facts which seem to bear upon it. The grade adopted in building the canal from Harrisburg west along the Juniata was doubtless determined partly by two things. First, safety from freshets, and, second, the height and consequent cost of the dams by which the canal was fed. It can hardly be supposed though, that any grade would have been adopted which did not seem to be above the danger of high water, merely to save cost in construction of a few higher dams.

It is a matter of history that the time did come when the canal was frequently overflowed, damaged and broken. It is also worthy of note that when the Pennsylvania Railroad was constructed through the same valley a higher grade was adopted, evidently, in part at least, to make it more secure against high water. But even this does not appear to have been always high enough, especially during the past few years. If we were to shift the point of observation, it would certainly be noted that the highest stage of water ever recorded along the Susquehanna just below Harrisburg was recorded since and during 1889. It will also be noted that the height of our bridges (constructed by the counties), above the ordinary stage of the water has constantly been increased, as one after another has been swept away by the frequently recurring freshets. Surely this points, if it points to anything, to the general belief that the floods are becoming higher. It may, of course, be answered that this may be due to a cycle of years (as it does so happen) in which the rainfall has been unusually severe, and that it has no necessary connection with the removal of timber from the headwaters of the streams. To this no absolute answer can be made, because time is the only solution. It seems to be harder to accept the cyclic theory than to believe the more obvious relation of the forests to water stages.

See Plates 16, 17, 18, 19 and 20.

One statement might be added here. The Upper Mehoopany creek, in Wyoming county, flows through a very hilly region, where the drainage might well be supposed to be rapid. I noticed a very old bridge which stood but little above the creek, and made inquiry if the bridges were not frequently swept away by flood, but received the answer that they were not, "because," said my intelligent informant, "our hills are mostly timbered to the top, and they hold the rain and delay the melting of the snow."

Your Commission has had compiled from all the data forwarded to the office the following table:

In the autumn of 1894, the Pennsylvania Forestry Commission communicated with the commissioners of the several counties and asked them to inform the Commission "what the repairs and renewal of highways and bridges damaged or destroyed by high water had cost the county, since and including the Johnstown flood." Results are given below:

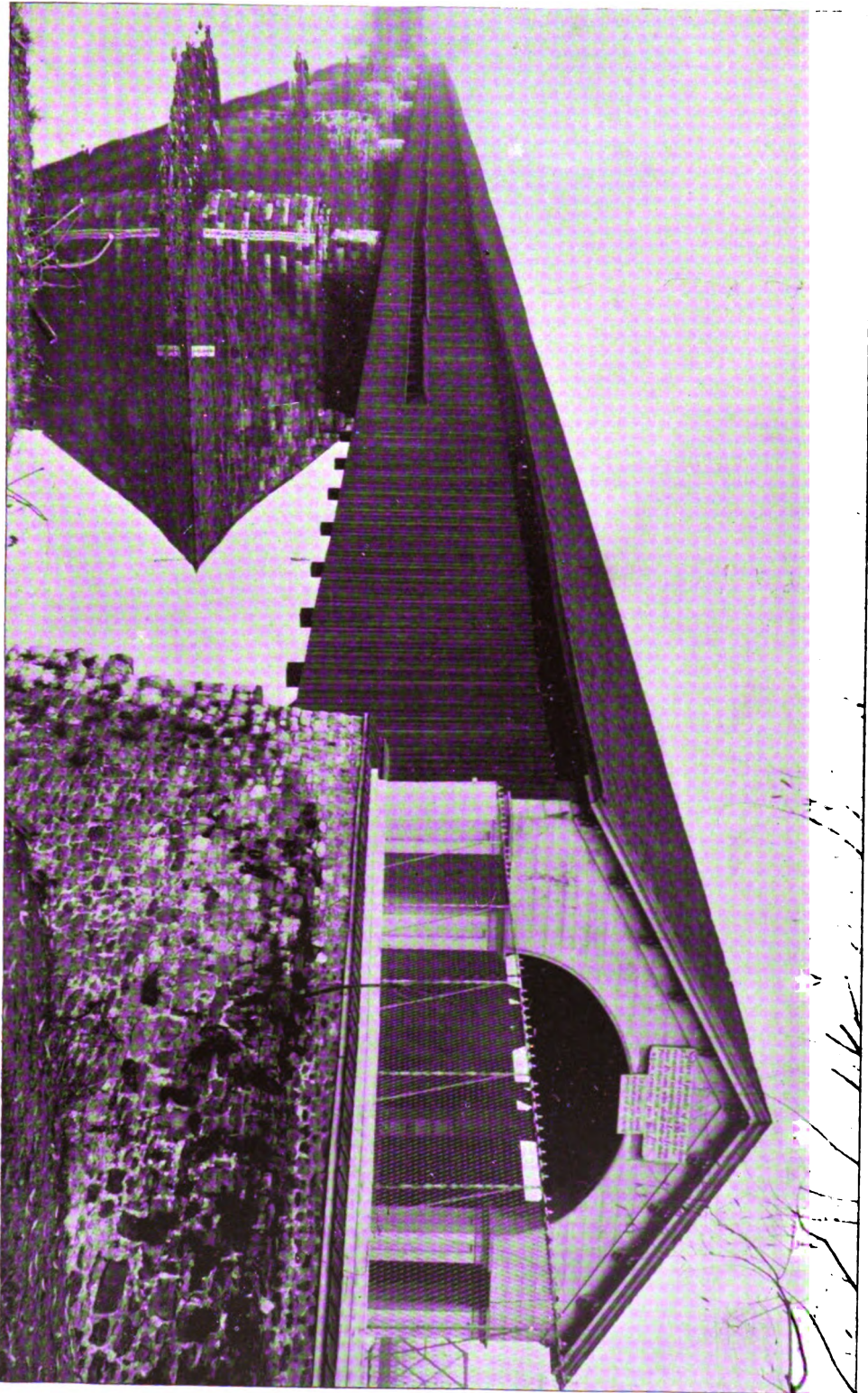
County.	Remarks.	Clerk of Commissioners.
Bedford.	The flood of 1889 cost the county for destruction of bridges, \$33,000 00 For 1894, 2,850 00 \$35,850 00 Can give no figures for roads.	J. T. Shaffer, Bedford.
Blair.	From January, 1889, to October, 1894, new bridges and repairs to old ones have cost, \$118,133 43 Highways are under the supervisors of the townships.	W. S. Hostler, Hollidaysburg.
Bradford.	No bridges lost or damaged since 1889,	John H. Dean, Towanda.
Elk.	About, \$17,000 00	John Nissel, Ridgway.
Juniata.	No report of highways, Spent on bridges--1889, \$20,569 78 1890, 15,256 03 1891, 16,734 45 1892, 5,336 20 1893, 841 71 Part of 1894, 5,229 43 Paid for bridges purchased, 54,816 00 Remaining unpaid, 7,313 21 \$126,101 81	Wm. N. Groningen, Mifflintown.
Lycoming.	Repairs from June 1, 1889, to November 1, 1894, \$12,932 44	T. R. Winder, Williamsport.
Mifflin.	Cost of repairs and renewals of roads and bridges for the time indicated-- County, \$80,000 00 Townships, 20,000 00 \$100,000 00	J. S. Rakerd, Lewistown.
Perry.	1889, including Johnstown flood, \$13,261 29 1890, including Johnstown flood, 35,764 10 1891, 6,710 07 1892, 11,848 92 1893, 14,048 97 \$99,633 35	M. B. Anderson, New Bloomfield.
Snyder.	Repairs and renewals of bridges from 1889 to 1894, \$36,264 00 Of highways, 10,000 00 \$46,264 00	J. W. Swartz, Middleburg.
Sullivan.	High and dry; out of the reach of floods,	John E. Gallagher, LaPorte.

County.	Remarks.	Clerk of Commissioners.
Susquehanna.	No renewal of bridges since Johnstown flood. For repairs to piers and abutments, \$463 63	E. G. Ball, Montrose.
Tioga.	Cost for time indicated-- Construction of new bridges, \$83,455 26 Repairs on bridges, 5,301 23 Road and bridge views, 2,090 55 Damages on new roads, 3,770 00 \$94,627 04	Frank Watkins, Wellsboro.
Union.	Lost by flood of 1889 in county bridges and roads, \$20,000 00 Our county's share of Bridge at Milton, destroyed by the flood of 1889, 36,000 00 Other damages by high water, 1,500 00 \$57,500 00	Frank Halfpenny, Lewisburg.
Wyoming.	Damages from floods during the time indicated, about \$2,500 00	E. E. Brown, Tunkhannock.
	The aggregate of repairs and renewals of bridges and highways is as follows during period above indicated-- Bedford county, \$38,850 00 Blair county, 118,133 43 Elk county, 17,000 00 Juniata county, 126,101 81 Lycoming county, 12,932 44 Mifflin county, 100,000 00 Perry county, 99,633 35 Snyder county, 46,264 00 Susquehanna county, 463 63 Tioga county, 94,627 04 Union county, 57,500 00 Wyoming county, 2,500 00 \$714,006 70	

It should be added that the above does not include some of the losses which are known to have occurred, but of which no statistics could be obtained in time for this report. The bridge built in 1894 at Williamsport is an example.

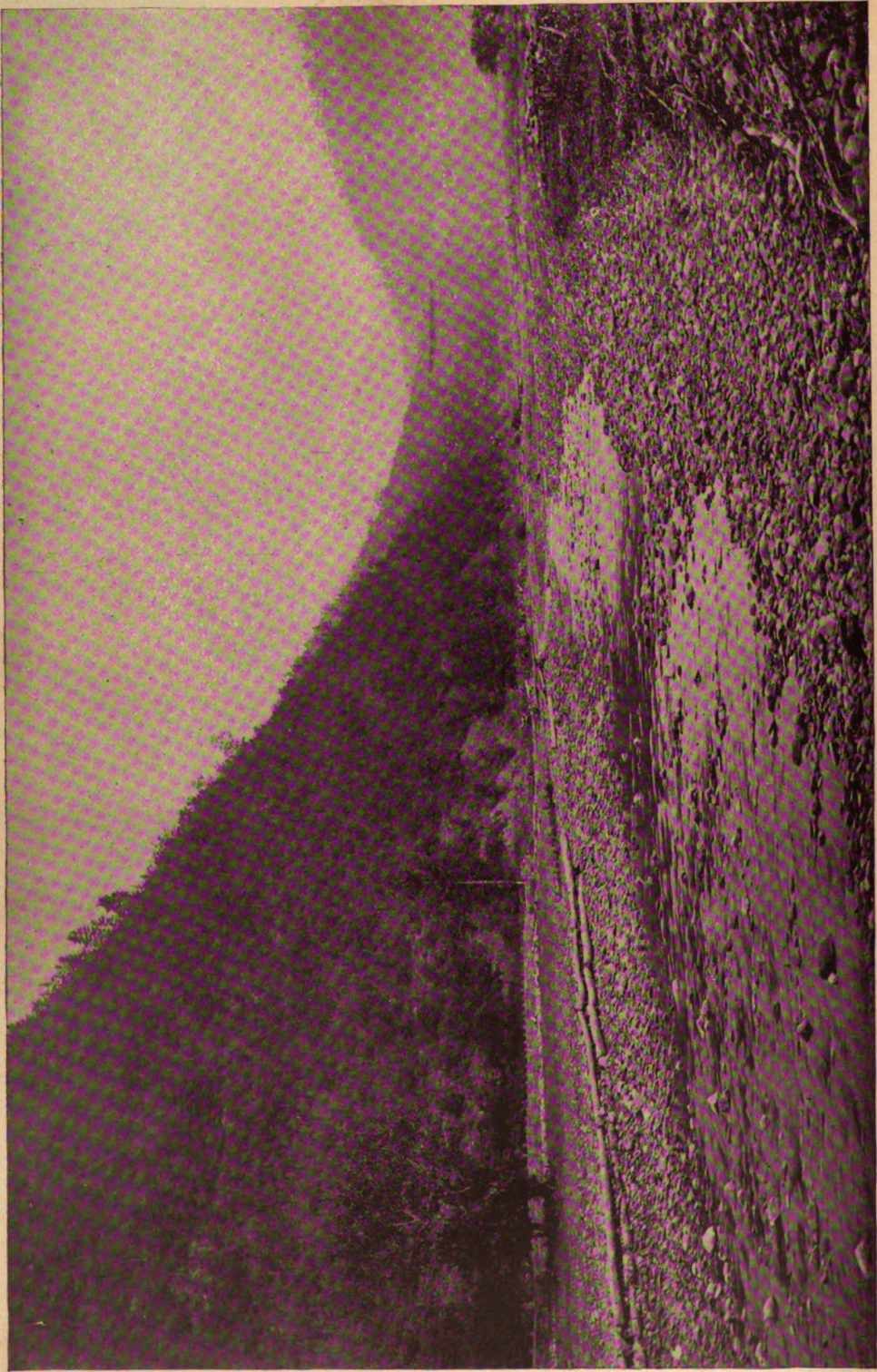
The above remarks are based on the idea that if an excess of water has rushed out of the country because of its timberless condition, there will remain so much less in the soil to maintain an even flow of water in periods of prolonged droughts.

We will refrain from drawing any conclusions, but simply give some facts as observed. The Towanda creek, in Bradford county, is ordinarily a stream, where observed by us, of about fifteen to twenty yards wide, and with a average depth of a few inches. These proportions, however, are irrelevant. The fact is, it is the main stream and is ordinarily several times larger than the Shrader branch that flows in from the southwest. At the time of my visit to this region, in the past summer (1894), during the drought, the Towanda, which flows in the main through an open country, was extremely low and carried but little more water than the Shrader branch, which headed



(Plate 17. See page 76.)

Low Water at Harrisburg, October, 1895.



(Plate 18. See page 76.)

Low Water at English Centre, on Little Pine Creek, Lycoming County, Spring of 1894. View up Stream.



in the wooded hills and flowed through a country which was much less cleared than that from which the Towanda had come.

Another example was furnished by "Dry Run," a tributary of the Wysox, in the same county. It was wholly dry as the illustration shows. It was, however, no mere channel for sudden heavy rainfalls, but ordinarily a constant stream. It likewise runs through an open country, and becomes a destructive torrent as my informant, Mr. Louis Piolet, stated: (see Plate 20) it is said to have flowed formerly during the entire year. I am informed by Mr. William Sturdevant, a most competent engineer, that the low water mark of the North Branch of the Susquehanna has fallen at least a foot at Wilkes-Barre during the last twenty years. There is, however, much to be said on both sides of this question. There is a tendency among cultured men to place small trust in the observations of men who do not claim to be scientists. But it must be remembered that many of the most important discoveries have been heralded by the very class of observers whose testimony is so often slighted.

In determining the question as to whether or not the average volume of water has decreased in our streams as the forests have been removed, we have been glad to obtain the statement of gentlemen from all portions of the State. In most instances they have resided long in the regions from which they have written, and their opinions are of great value. This has been designated as the historic method, in contra-distinction to that by meteorologists using instruments of precision, which is the scientific method. The time will come when the latter method will, of course, lead to results which are unassailable; but for the present, the historic plan is probably as little likely to involve error as the scientific.

We believe the following table to be of great value and introduce it accordingly. It would seem to show that there has been a decrease in the volume of water carried by our streams during the summer months of recent years, and a corresponding increase in the tendency of springs once "never failing" to become dry.

The following questions were sent out in March, 1894, to obtain information as to whether the volume of water flowing in our streams at the present time is greater or less than formerly:

1. Can you name and locate any stream or streams in which you know there has been a change in the quantity of water carried?
2. To what do you think the change is due in each case?
3. Do these streams flow through level, hilly or mountainous country?
4. Is there much or little forest growth about their head waters?
5. Do you know of any mills which once ran by water power alone, but which now require steam wholly or in part? If so, please name and locate them.

6. Is the steam required by increase of business or by failure of water supply?

7. Do you know of springs, which once were "never failing," but which now become dry in dry seasons?

8. What is the character of the country around such springs, as to relative extent of woodland and clearings, and what in your opinion has produced the change in the springs?

9. Please sign your name clearly, giving post office address, and mail reply to

"THE FORESTRY COMMISSIONERS,
Harrisburg, Penna."

	Adams.	Allegheny.	Allegheny.	Armstrong.	Armstrong.	Beaver.
1. . . .	Rock creek is now very small.	Beaver River. Brady's run. Ohio river.	.....	Catawissa springs, at Honey brook, in the coal regions.	Big Mahoning. Little Mahoning. Allegheny river.	Little Beaver creek.
2. . . .	Due to the cutting away of the timber along the stream.	Cultivation of the land. Destruction of the forests.	Clearing of the forests; greater absorption of the rainfall in the cultivated ground.	Destruction of the forests.	Cutting and destruction of forests.	Clearing of timber and drainage of swamps, which acted as reservoirs.
3. . . .	Through a level country.	Hilly.	Through hilly regions.	Hilly and mountainous.	Mountainous and hilly.	Headwaters fairly hilly for the last 12 miles.
4. . . .	There is little forest growth along the head waters of this stream.	Have no knowledge.	Very little left.	None.	Along the head waters of our larger streams the forests are rapidly disappearing.	Four-fifths of the forest about head waters has been cleared.
5. . . .	Asper's Mill on Opposum creek is run partly by steam, formerly entirely by water power.	Don't recollect.	Of many grist and saw mills formerly run by water, not one now remains.	Moses & Haghn run wholly by water. Chas. Wagner, part by water and part by steam.	Glade Run mills. Cowanshono mills. Little Mahoning and others.	Enon Valley Flouring Mill. Lipp Bros., Ohio. Peterson's Flouring Mill. Little Beaver Wool Co.
6. . . .	On account of the scarcity of water.	Yes.	Mainly from failure of the water supply.	Failure of water supply and excess of coal dirt.	By failure of the water supply.	Drought and no reservoir renders steam necessary.
7. . . .	I can not.	Have no knowledge.	Yes; in Washington county.	Yes.	I know of a large number.	One in my orchard dries out two years in seven.
8. . . .	.....	Have no knowledge.	Same causes that diminished the streams.	Rolling country and absence of timber growth.	But little wood land exists where such failures occur.	No reason, only from clearings. Farms would be called hilly.
	N. G. Wilson, Gettysburg.	Edwin H. Stowe, Pittsburg.	J. W. F. White, Pittsburg.	Nelson Brandon, Brandywine, Schuylkill county.	D. W. Lawton, Dayton.	Ira F. Mansfield, Beaver.

	Bedford.	Bedford.	Bedford.	Bedford.	Bedford.	Bedford.
1. . . .	Sideling Hill Creek. Raystown Branch.	All the streams in this vicinity.	Three springs. Beaver Run. Meadow Branch. Yellow creek.	Hurricane branch, Shepherd's branch, have less water.	Six Mile run, a branch of the Juniata.	Bedford. Raystown branch has changed materially.
2. . . .	Clearing out the for- ests, opening the channels of small streams.	Clearing out of the for- ests.	Clearing out of the land-wide roads and channels.	Clearing of the land; increased evaporation in consequence of less shade.	Removal of timber.	Stream falls lower, rises more quickly than it did thirty years ago.
3. . . .	Hills and mountains.	Some through level, mostly through hilly country.	Surface rolling, sur- rounded by moun- tains.	Flow through hilly countries.	Mountainous.	Hilly and mountainous.
4. . . .	Considerable growth along the head waters of these streams.	Considerable forest, but getting less each year.	Headwaters are largely covered with forest.	Cleared land nearly all the way from the source.	Not much; mainly sec- ond growth.	A large forest growth still on the moun- tains.
5. . . .	Jackson's Mill. Aker's Mill.	Wm. Colon's mill. A. E. Ryan's mill.	Old poor house mill. uses steam at times, others do the same.	George A. Sleek's mill. Wm. Colvin's mill, have steam power at- tached.	There were mills on Six-Mile run, but not sufficient water at present.	Jackson's mill, Rolun's mill, and some that have been abandoned.
6. . . .	Increase of business.	Mostly by increase of business; partly by failure of water sup- ply.	Increase of business; irregularity of water supply.	Increase of business.	No.	Failure of water sup- ply.
7. . . .	I do not.	No.	One very fine spring.	Ground nearly all cleared.	No.	Yes; in many locali- ties.
8. . . .			Comparatively even cul- tivation of the land; removal of the for- est.	I can not.		Most of the springs are in ravines. Water falls where the tim- ber has been de- stroyed.
	J. M. Robinson, Clear- ville.	Isiah Conley, Schella- burg.	John B. Flack, Loys- burg.	D. M. Wonders, New Paris.	Wm. Lauder, Riddles- burg.	C. D. Masters, Everett.

	Bedford.	Bedford.	Bedford.	Berks.	Berks.	Blair.
1. . . .	I can not.	Meadow Branch. Three Spring Run. Beaver Run. Potter Creek.	Have been operating a saw mill by water power since 1848.	Can see no differ- ence in the Tulpe- hocken.	Tulpehocken and Ca- coosing.	None.
2. . . .	More excessive rains droughts.	Streams become less as the country is cleared of timber.			Clearing off the timber.	
3. . . .	Mountainous and hilly.	Through hilly or broken country.			Both level and hilly.	
4. . . .	Streams flow from springs upon our hills and mountains.	Very little at this time.		This stream rises in level ground, and passes through a hilly territory.	But little.	Our streams rise in the mountains or wooded land.
5. . . .	I know mills that once run by water now driven by steam.	Do not know of any at present.	D. W. Prosser's Bare- foot at Pleasantville.	None are using steam at present.	Haine's Mill. Van Reed's Mill. Cannot run full time as water mills.	I do not know of any.
6. . . .	Principally from an in- crease of business.		Both causes combined.		Failure of water supply.	
7. . . .	The courses of water have generally chang- ed.	Several in our commu- nity.	I do not think of any.	No; unless you mean winter springs.	Yes; several.	No.
8. . . .	Generally fine and loose bavel on the hills; lower lands composed of clay.	Caused by clearing of the timber.		We have no wood land in this part of the country.	Clearing generally.	
	Hiram Blackburn, Fish- ertown.	S. B. Fiske, Wood- bury.	Jos. H. Griffiths, Pavia.	E. S. Wertz, Reading.	Sam'l B. Keppel, Sink- ing Spring.	Aug. S. Landis, Holl- daysburg.

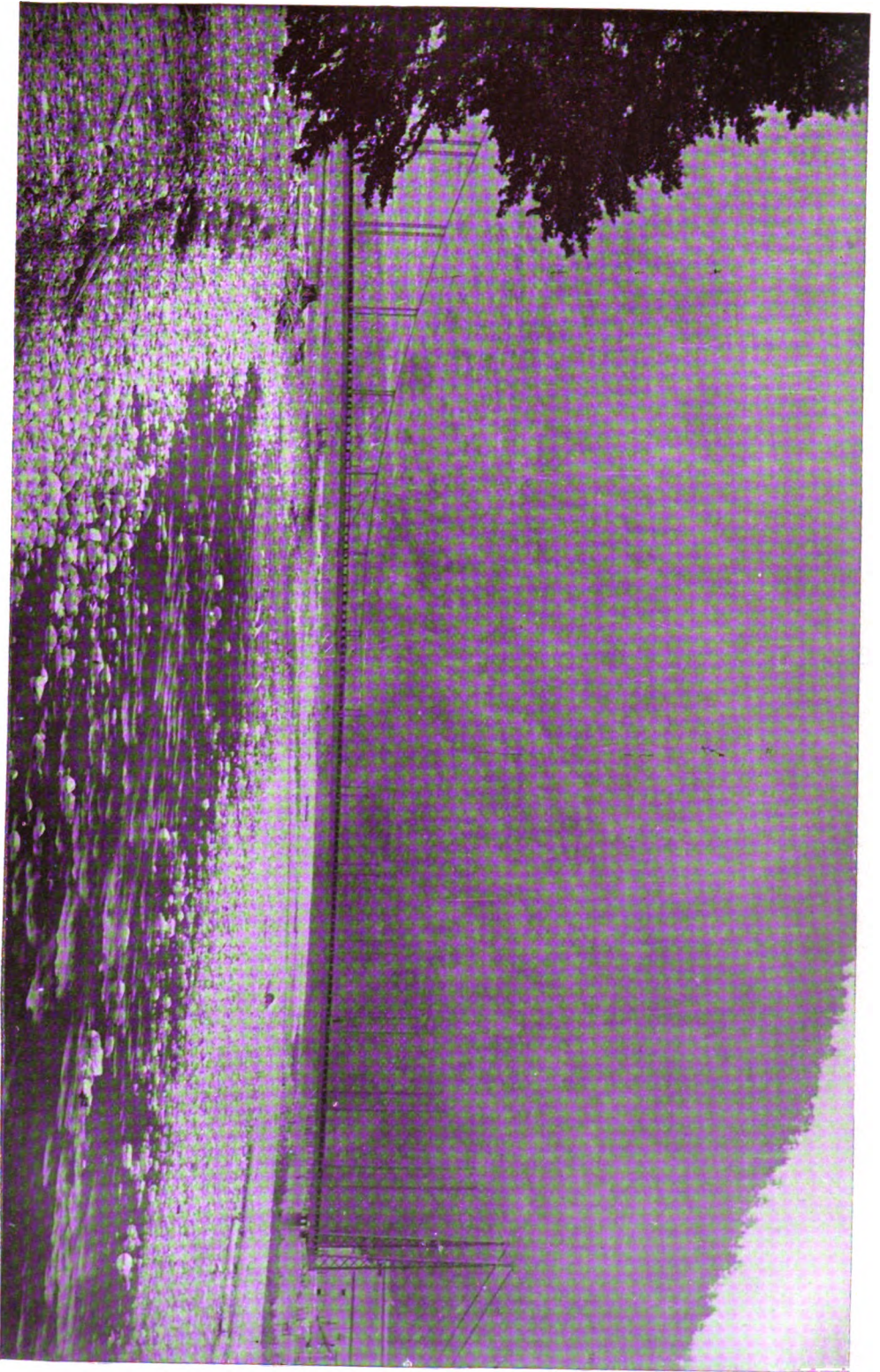
	Blair.	Bradford.	Bradford.	Bradford.	Bucks.	Bucks.
1. . . .	No. I suspect such is the case.	Towanda creek. Sugar creek.	Sugar Creek and its tributaries.	Wycox Creek. Wapashinnig; both emptying into Sugar Creek.	Pine Run has not the water it used to have.	Yes.
2. . . .	.....	Cutting and converting the forests into farm lands.	To the settling and clearing up of the country.	Clearing up of the country.	Because the timber has been cut off.	Water courses are filling up. The water spreads over the land.
3. . . .	.....	Hilly and mountainous.	Mostly hilly and mountainous.	Hilly.	Flows through a level country.	Level.
4. . . .	.....	Very little.	Not much at present.	One-fourth of the country is still timbered.	Very little forest growth at the head waters of the streams.	Has been cut out.
5. . . .	.....	Hageman's Mill. Holcomb's Mill. Other mills on Sugar creek.	Long Mills. Velle's Mills. Canton Mills. All require steam.	Barnes' Mills, Syfers' Mills, Kuykendall's Mills require steam.	Dyerstown Mill, Dettweiler's Mill; both now run by steam.	Some are run by water alone. Some use steam on account of business.
6. . . .	.....	Failure of water.	Both; but mostly the latter.	Failure of water power.	Increase of business and failure of water.	More business and less water.
7. . . .	.....	I do.	Yes.	Have three springs that cannot be depended on.	I know of some that go dry now, that never did before.	No.
8. . . .	.....	Change due to the removing of the timber.	Clearing up of the country.	Ten per cent. of woodland.	Very little timber around such springs.	No change that I know of.
	Dr. S. C. Baker, Altoona.	Wm. H. Minor. Towanda.	B. B. Mitchell, Troy.	F. N. Moore, North Orwell.	Carlie Shepherd, Doylstown.	Jas. L. Fabian, Tullytown.

	Butler.	Butler.	Butler.	Cambria.	Cambria.	Cambria.
1. . . .	Neshannock creek.	Conoquenessing creek.	Conoquenessing creek and Glade run.	South Conemaugh and tributaries.	Chest creek and its tributaries are not one-half of what they were.	Little Conemaugh and branches.
2. . . .	Clearing the land drained by this stream.	Clearing away the forest.	Due to the unlimited destruction of the forests.	By the forest being cut off.	Removal of the timber.	Clearing away the forest.
3. . . .	Not mountainous, but rolling.	Flows through hilly country.	Partly level and partly hilly.	Partly level and partly hilly.	Hilly.	Mountainous country.
4. . . .	Not much.	Very little forest growth at its headwaters.	Scarcely any.	Very little.	Little.	Much less than formerly.
5. . . .	Ravy Milling Company, Pearsdon's.	Do not know.	Nearly all the country mills have resorted to steam.	Do not.	Streams that operated mills 40 years ago, will not now turn a wheel.	Steam-mills have been mostly used for the last 23 years.
6. . . .	By both.	Do not know.	Failure of water supply.	.....	Failure.	Water would not do the work fast enough.
7. . . .	No.	Do not know.	It is the exception to find one now that never fails.	Some small springs.	Many of them.	.....
8. . . .	.....	.....	Country is nearly all cleared. Farms suffer from the loss of forest protection.	By the timber being cut off.	Removal of the timber.	.....
	Aaron L. Hazen, New Castle.	Jas B. Males, Butler.	D. B. Douthett, Brownsdale.	Jacob C. Stineman, So. Fork.	J. J. Thomas, Patton.	Dr. J. C. Blalodell, Wilmore.

	Cambria.	Cambria.	Cambria.	Cameron.	Carbon.
1. . . .	Little Quest Creek. Storm's Run.	Ben's Creek. Hinkson's Run.	Conemaugh.	All our streams are subject to higher or lower water.	Lehigh river and all smaller streams.
2. . . .	Timber being removed from vicinity of streams.	To the cutting away of the timber.	Cutting the timber off.	To the fact that the forests have been cut away.	To the destruction of the forests.
3. . . .	Through a hilly and mountainous country.	County is generally hilly.	Hilly.	Mountainous.	The hilly country abounds here.
4. . . .	Little and much.	Considerable growth about their headwaters.	Nearly all cut off.	Considerable.	Still a light forest growth.
5. . . .	Sybert's Mill. Dawson's Mill.	Mills require steam four or five months in the year.	My mill runs by water. Ludwick's uses water and steam.	No.	As the timber is gone there is no use for mills.
6. . . .	By both.	By failure of water.	Failure of water.	.....	.....
7. . . .	No.	I know of three that have gone dry since the timber was cut.	There are some.	No.	I do not know of any.
8. . . .	.....	They were in a wooded tract, now cleared	Cutting off the timber allows the ground to dry.	.....	The virgin forest of 20 years ago has been destroyed by men and fires.
	P. A. Sybert, Gallit- zin	D. B. Wilson, Mineral Point.	D. A. Sipe, Sumner Hill.	Irwin K. Hockley, Em- porium.	W. F. Biery, Wides- port.

	Carbon.	Centre.	Centre.	Centre.	Centre.	Centre.
1. . . .	Mud Run.	Bald Eagle, Beech Creek, Moshannon's.	Bald Eagle carries more water at the end of a freshet.	Bald Eagle creek has greater floods and gets lower in dry seasons.	Swift Run and Havice Valley stream has less water now than formerly.	Laurel or Elders run.
2. . . .	Trees which shaded the ground have all been cut down; the sun dries the ground.	The country through which they flow has been cleared.	To the clearing of the land.	Probably due to the clearing the valley and adjacent hills.	Cutting off the timber is the cause.	Being denuded of its timber for the whole distance.
3. . . .		Both valley and mountainous country.	It flows down a valley; the water comes from the Alleghenies.	Flows through a level country, but its tributaries are mountainous streams.	Mountain country.	Heading in the mountain gorges, passes through the foot hills in narrow valleys.
4. . . .	No; not much.	No; not much.	Quite a portion is moderate forest growth.	The former heavy growth of timber has been all cut or burnt off.	Timber is all cut off, but the good soil remains.	There was heavy growth of hemlock and pine which would be replaced if the fires could be kept out.
5. . . .	I have the only steam saw mill in this section on account of low water.	A saw mill's foundry and grist mill have been abandoned for want of water.		The grist mill at this place formerly run by water, now runs by steam in dry weather.	Bendick's grist mill for last five years can't run half time.	Two saw mills and a flouring mill can't run one-half time with water.
6. . . .	Business is getting less on account of the timber being cut off.			Failure of the water supply.	Failure of water.	Power is required for mills and will have to be supplied.
7. . . .	Springs have much less water than they had years ago.	Any number have failed entirely.	I have a spring that since the land has been cleared falls in dry seasons.	I have heard of such springs.	Yes.	Numbers of them.
8. . . .	Change in the springs caused by clearing off the timber.	It has been cut off or burnt away.		Country is hilly and mostly cleared.	Mountainous timber cut away.	Mostly stripped of timber.
	J. S. Hawk, Mud Run.	P. Gray Meek, Bellefonte.	W. P. Fisher, Fleming Centre.	Samuel Brugger, Fleming.	W. H. Culberson, Mithelm.	John A. Hunter, Stormstown.

Centre.	Centre.	Chester.	Chester.	Chester.	Chester.
1.	Eddy Lick. Panther Run. Spruce Run. Fine Run.	No. sir.	No.	Pickering creek. White Clay creek.	The streams that I know maintain their normal condition.
2.	Timber has been cut off and fire followed.				
3.	Some through level, others through moun- tainous country.			Hilly.	Generally through an abrupt country.
4.	None at all.			Moderate supply.	Through heavy timber- ed land.
5.	The water mills were let go down years ago and steam took their place.		I do not.	I do not.	Not any.
6.	By failure of the water supply.				Increase of business.
7.	I knew many.	No.	Yes.	I do.	Not any.
8.	Always a growth of timber around these springs.		Clearing off the timber has produced the change.	Little wood land now, where it was very heavy formerly.	An agricultural district with heavy timber land.
	Geo. R. Boak. Pine Glen.	H. C. Brew, Bellefonte.	Geo. R. Talbot, West Chester.	J. G. West, Kimbles- ville.	David H. Branson, At- glen.



(Plate 19.)

View at English Centre, Lycoming County. The Water Shows the Stream at Low Stage. The Bridge Indicates Height to which Water Rises During Freshets.



(Plate 20. See pages 76 and 79.)
Dry Run, Bradford County.

	Clarion.	Clarion.	Clearfield.	Clearfield.	Clearfield.	Clinton.
1.	I know of none.	Do not observe any material change in 40 years.	Streams in our section have less water than formerly.	West Branch of the Susquehanna.	In every stream in the county the water is lower during the dry season.	Big Fishing Creek, leading into Sugar Valley.
2. . . . .	.....	.....	Owing to the forest being cut away.	Destruction of the forests during the last thirty years.	To the destruction of the heavy forest that kept the water.	Cutting the timber and clearing the land.
3. . . . .	.....	.....	Our country is quite hilly.	Rise and flow through a hilly country.	Mountaneous.	Part through level; most through the mountains.
4. . . . .	.....	More or less forest growth along the streams.	Much of the forests are being cut away at the headwaters.	A great extent, except where it has been destroyed by fire.	Vast areas if protected from fire would rapidly grow into value.	Formerly, but is getting cleared away.
5.	Use a modern style wheel with lack of water power.	Mills situated on the streams sometimes stand idle for want of water.	Yes; several that run by water formerly are now run by steam.	Water powers on the West Branch, formerly most valuable, have been abandoned.	Can't say.	W. H. Long has added steam to the water power.
6.	Failure of the water supply.	Volume of water is nearly the same.	Mostly by increase of business.	Failure of the water supply.	Yes.	Failure of water supply.
7.	No.	I do not.	Our spring has failed twice in five years that never failed before.	.....	Can't name any; but the fact exists nevertheless.	I know a large spring, now dry a part of the time, formerly never dry.
8. . . . .	.....	Do not see any difference between springs surrounded by woodland or by cleared land.	Formerly heavy timbered, now mostly cut away.	Much of the woodland has been cleared, allowing the water to run off.	.....	In a valley by the roadside, now surrounded by cleared land.
	H. N. Ness, Clarion.	Henry Cyphert, Kingsville.	E. M. Davis, Gramplan.	J. Blair Reed, Clearfield.	David L. Krebs, Clearfield.	I. S. Frain, Abdera.

	Columbia.	Columbia.	Crawford.	Crawford.	Dauphin.	Delaware.
1. . . .	Little Fishing Creek. Big Fishing Creek.	Fishing Creek. Catawissa Creek. Roaring Creek. Muncy Creek.	French Creek. Crooked Creek. Shenango Creek.	The streams in this county carry less water than in former years.	There are several streams with less water than formerly.	Eastern branch of Naman's Creek.
2. . . .	Removal and the destruction of the timber during last ten years.	Destruction of the forests and frequent fires.	Clearing off the timber land.	Evidently the destruction of the forests.	Cutting and clearing away the timber.	Cause was the cutting down of the forests.
3. . . .	More or less hills and valleys.	Level, hilly and mountainous.	Hilly.	Level and hilly.	Moderately hilly.	Country is undulating.
4. . . .	Greater part is being destroyed.	Has been greatly reduced and growing less annually.	Limited amount. Shenango has its head in a swamp.	Forests are cleared away; a smaller growth of trees and bushes.	Much less than formerly.	Were heavily wooded; now the wood has disappeared.
5. . . .	Mills in low water time are obliged to stand or use steam.	Muncy Mills, McFarland's Mills, Mill & Fishing Co.	Several flouring mills.	No mills dependent on water; once there were hundreds.	.....	A grist mill in Chichester, formerly run by water, has been abandoned for more than 20 years.
6. . . .	Failure of streams, not excess of business.	Failure of the water supply.	Failure of the water supply.	Failure of water all ways.	.....	Steam power has been introduced where water power is abandoned.
7. . . .	There are such never failing springs that now fail at every drought.	A few much reduced in flow.	Don't know that I do.	The unfailing spring is now the exception.	Yes.	Three springs never failing 60 years ago, are now nearly dry.
8. . . .	The lands about them have been cleared and farmed for many years.	Has been cleared for farming purposes.	.....	Timber is now in small disconnected bodies.	Formerly wooded; now cleared.	Removal of the forests has caused the drying up of the springs.
	Jonah Heacock, Millville.	Rev. W. Myers, Catawissa.	Robt C. McMaster, Adamsville.	S. T. Logan, Hartstown.	J. W. Simonton, Harrisburg.	Thos. J. Clayton, Chester.

	Elk.	Erie.	Erie.	Erie.	Erie.	Erie.
1. . . .	All the streams have decreased in the quantity of water.	The streams carry less water than formerly.	French Creek. Elk Creek. 16 Mile Creek. 20 Mile Creek.	Every stream has been decreasing in volume.	Six Mile Creek. Four Mile Creek. Mill Creek. Walnut Creek.	French Creek and its tributaries.
2. . . .	Laying bare the hills by cutting the timber.	Clearing the timber from the lands.	Clearing away of timber.	To the cutting away of the forest.	Clearing the land from timber.	Cutting and clearing off the timber and opening ditches.
3. . . .	All flow through hilly country.	Generally level or undulatory.	Hilly.	Hilly country.	Rolling country; portions comparatively level.	Level, sometimes hilly.
4. . . .	But little forest growth. Young trees start, but are destroyed by fire.	No forests in the country.	Very little now.	Little compared with former years.	Little at present.	Very little at this time.
5. . . .	Number of mills abandoned; formerly run by water power.	I know of none.	Mills all over the country.	But two or three that can depend on water.	Most of the mills run by water have been abandoned.	Water power in the larger streams not much less, but it shows in smaller streams.
6. . . .	Increase of business and failure of water supply.	.....	Failure of a water supply.	Failure of the water supply.	Failure of water supply; some increase of business.	Partly both.
7. . . .	Yes; a great many.	There are some, but not materially affected in dry seasons.	Yes; plenty of them.	Yes; all through our country.	All the small streams in the county now become dry.	.....
8. . . .	The timber has been removed; the springs become dry in summer.	Nothing peculiar about the character of the country.	Removal of the timber in all cases.	The country is cleared of woods.	.....	.....
	Chas. Jahr, St. Mary's.	D. B. McCreary, Erie.	J. Ross Raymond, North East.	B. B. Whitley, Erie.	Frank Gunnison, Erie.	Chas. M. Wheeler, Le Boeuf.

	Fayette.	Fayette.	Fayette.	Franklin.	Fulton.	Fulton.
1. . . .	Redstone Creek.	All our streams carry less water than formerly.	It is increased.	Conedogwinet.	I do not think there is any change.	Cove Creek. Licking Creek.
2. . . .	Clearing away of timber.	Clearing and drainage of land.	Cultivation and drainage.	Due to the clearing out of the timber.	.....	Cutting way the timber on the mountains.
3. . . .	Mountainous.	.....	Hilly and mountainous country.	Part mountainous; part hilly.	Hilly.	Hilly and mountainous.
4. . . .	Not at present.	Much forest still remains on the mountains.	More or less forest growth about all the headwaters.	Quite a lot of timber at its source.	.....	Considerable.
5. . . .	Valley Mills. Champion Mills.	Formerly all mills had water power; most now are driven by steam.	I do not know any such.	.....	Do not know of any.	Not on these streams.
6. . . .	Failure of water supply.	By both causes.	By increase of business.	.....	.....	.....
7. . . .	Yes.	No.	No, sir.	Have heard of several.	None that I know.	I do not.
8. . . .	Due to mining.	General clearing and drainage of the land.	There is no change.	Timber not plenty near these springs as formerly.	.....	.....
	Chas. H. Brooks, Normalville.	William Beeson, 31 W. Fayette St., Uniontown.	Jacob N. Ritnour, Normalville.	Wm. M. Brown, Chambersburg.	Geo. A. Stewart, Well's Tannery.	Geo. W. Skinner, Big Cove Tannery.

	Fulton.	Indiana.	Indiana.	Juniata.	Lackawanna.	Lackawanna.
1. . . .	Not much, if any, change in the annual average volume of water.	Little Mahoning Creek.	Black Lack Creek. Brush Creek. Yellow Creek. Crooked Creek.	Our small hilly streams are not as strong as forty years ago.	Lackawanna River. Roaring Brook. Lehigh River. Tobyhanna Creek.	All the small streams emptying into Roaring Brook, Lehigh and Paupack.
2. . . .	.....	Including the forests at the headwaters of the streams.	Quantity of water diminished one-half; due to the clearing out of the forests.	Cutting off timber and cultivation.	Cutting away the forests from the sources of the stream.	Cutting down the forests.
3. . . .	This section is all mountainous and hilly.	Hilly generally.	Hilly and rolling country.	Generally rolling.	Mountainous.	Through a hilly country.
4. . . .	Streams generally have their sources in the mountain forests.	There have been large forests in former years.	Not much.	Very little, except a few streams.	Very little forest growth now.	A little forest growth.
5. . . .	Most of the mills have about the same water power as formerly.	Several mills running by water the whole year are now using steam power.	A very considerable number.	Steam has been used for about five years.	No.	All have had to change to steam or shut down altogether.
6. . . .	Is an increase of bushiness.	Both.	By both.	Both; I think.	Don't know.	Failure of water supply.
7. . . .	There are some such among the slate hills.	Yes.	Yes; many.	I know springs that are lower than they were 40 years ago.	No.	Yes; a great many.
8. . . .	Change is due to the clearing of land around them.	Land has been clear for years.	Timber and forests all cleared off.	Removal of timber and cultivation of the land.	.....	Clearings and cutting away the forest.
	James Pott, Big Cove Tannery.	Noah Seaton, Plumville.	Wm. Hosack, Indiana.	H. Latimer Wilson, Van Wert.	R. W. Archbald, Scranton.	W. K. Beck, Moscow.

	Lackawanna.	Lackawanna.	Lackawanna.	Lackawanna.	Lancaster.
1 . . .	The quantity of water carried by the Lackawanna and Roaring Brook is not as great as formerly.	Lackawanna River.	A small stream in Palmyra has more water than in former years. The Wallenpaupack has less.	Lackawanna and its tributaries.	No.
2 . . .	Amount required for manufacturing and the quantity in the shut up mines.	Cutting and taking off the timber.	On account of the destruction of the forests.	Cutting the timber from the valleys, hills and mountains.	Clearing the surface of forests and rubbish.
3 . . .	Mountainous country.	Hilly.	Quite mountainous.	The Lackawanna has an average fall of 25 feet to the mile.	Comparatively level.
4 . . .	Growth of timber is fair, but not so great as formerly by 25 per cent.	Very little now.	Considerable second growth.	Almost all cut away.	But little at the present time at the headwaters.
5 . . .		Three or four mills are abandoned; others are run by steam, that ran by water.	None.	Some two or three now run by steam, formerly driven by water.	Scores of mills have added steam to their power.
6 . . .	Increase of business coupled with decrease of water supply.	Failure of water supply.		Failure of water supply; culm for fuel is cheaper.	Increase of business and the failure of a constant supply of water.
7 . . .	Yes; many of them.	Yes; several.	Do not.	I only know that wells fail where coal is mined.	I know some such, and others that are altogether lost.
8 . . .	Hilly land is woody; water has been diverted into channels and reservoirs for various purposes.	Hilly and the wood cleared off.		No woodland left to speak of.	Woodland absent; surface undulating; limestone formation.
9 . . .	Jno. P. Quimman, Scranton.	M. T. Burke, 9 Pike street, Carbondale.	E. F. Killam, Scranton.	W. H. Richmond, Scranton.	Andrew M. Frantz, 238 East Orange street, Lancaster.
					A. G. Seyfert, East Earl.



(Plate 21. See page 46.)

Long Run, Clinton County. Nearly Naked Hills and Rapid Drainage Cause Very High and Very Low Water.

	Lancaster.	Lancaster.	Lancaster.	Lawrence.	Lawrence.	Lawrence.
1. . . .	Conestoga and its tributaries carry less water than formerly.	Big (biquasalunga, Donegal Creek, Muddy Run, Nisley's Run.	I cannot.	There is no less water in the streams than 60 years ago.	The Ohio River and its tributaries.	Branches of the little Back Creek run lower than in former years.
2. . . .	Have no theory.	Where the timber is cut away many small streams have disappeared.	.....	More imaginary.	Ignorant barbarism in cutting down the forests and planting no seeds.	Clearing out of timber and under-drainage of tillable land.
3. . . .	Rolling and hilly country.	Through level country.	.....	Partly the rocky gorges or canons; some third level, swampy country.	Not mountainous, but rolling.	Rolling country; slightly hilly.
4. . . .	Very little forest growth.	Very little forest growth.	.....	Considerable native forest at their source and along their sides.	Early headwaters of the Allegheny 60 years ago was cursed with fire.	No great body of timber.
5. . . .	Groff's, Summer's, Landis and Hershey's mills.	Large number of mills are now run by steam.	Cannot know that such is the case.	There was water enough for the mills 60 years ago.	Every mill has been compelled to use steam in whole or in part.	All water power mills have been abandoned.
6. . . .	.....	.....	Increase of business.	By increased capacity, requiring more power.	Failure of water.	Increase of business and scarcity of water.
7. . . .	Don't recall any now.	.....	I do not.	I do not.	Yes; many.	.....
8. . . .	.....	.....	.....	.....	Demand for railroad ties and fencing has left very little timber.	Change produced by the mining of coal; not for want of timber.
	John H. Landis, Millersville.	B. M. Gelder, Mount Joy.	Milton Heidelbaugh, P. O. box 371, Lancaster.	E. M. McConnell, 63 Crawford ave., New Castle.	A. B. Bradford, Enon Valley.	L. Martin, Enon Valley.

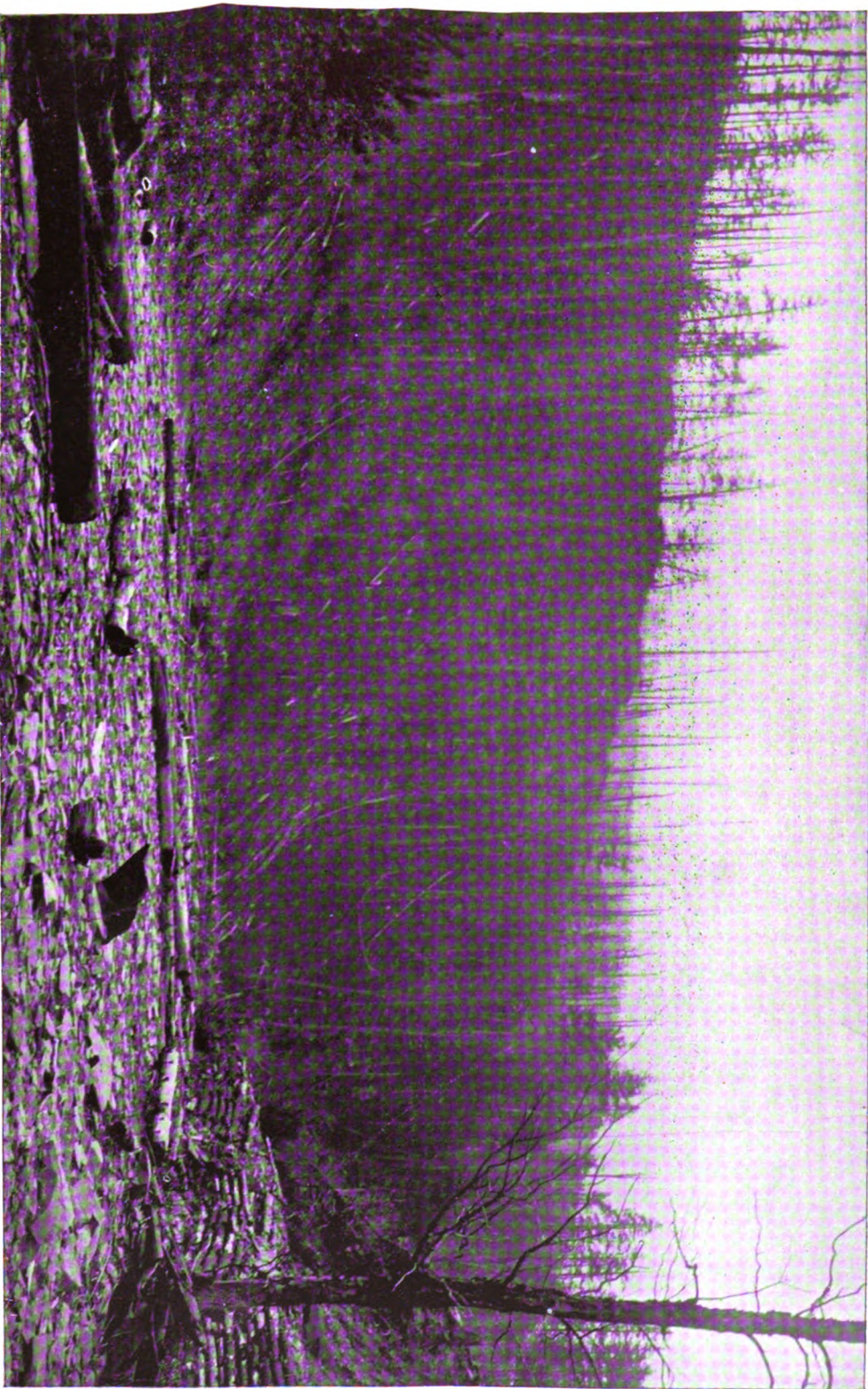
	Lebanon.	Lebanon.	Lebanon.	Lebanon.	Lebanon.	Lehigh.
1. . . .	The streams are small and no change apparent.	Not any.	Quittapahilla.	Raccoon Creek has only about one-half the water it had 25 years ago.	Hammer Creek.	Hosenasack Creek.
2. . . .			Due to forests being nearly all cleared out.	Our forests are being cleared away.	Wet and dry seasons.	Removing the forests and clearing the land.
3. . . .		Partly through hilly land.	Hilly and mountainous.	The Swatara runs through a level country.	One of its tributaries rises in steep mountains, the other in more level ground.	Hilly and mountainous.
4. . . .	Little.	A good deal.	Not any, excepting two, start in the mountains.	Very little forest growing along the streams.	The first named has a forest growth, the other has not.	Very little or no forest.
5. . . .	Mills once run by water power are now run by steam, with enlarged capacity.	M. W. McAlister's. David Helstead.	They all run by water except in very dry time.	Three mills that run by water must now run by steam or stop.	No.	I do not know of any one in these parts.
6. . . .	Largely by increase of business.	Don't know.	Increase of business and water failure.	Failure of the water supply.		
7. . . .	None to my knowledge.	Not any.	Very strong springs about hold their own.	Lots of them in the township.	Yes; one.	Yes.
8. . . .			Hardly any wood land in our vicinity; less wood land, less water.	Change in the springs is caused by the clearing of the wood away.	Character of the country has always remained the same.	Mostly by clearing the land.
	J. P. S. Gobin, Lebanon.	Chr. Gingrich, Lawn.	Henry S. Heliman Box 124, Sunnyside Mills, Lebanon.	J. A. Farling, Palmyra.	Israel W. Grow, Schaeferstown.	P. W. Flores, Dillingersville.

	Lehigh.	Luzerne.	Luzerne.	Luzerne.	Luzerne.	Luzerne.
1. . . .	No.	Streams are lower now in summer than when forests were standing.	Huntingdon Creek.	Tobyhanna Creek, Tunkhannock Creek and other streams; no permanent change.	Tobyhanna Creek, Tunkhannock Creek. Lehigh river have all lost one-third of their water.	Change in high and low water mark is about the same.
2. . . .	Streams are as high as they formerly were.	Exposure to the sun and greater evaporation.	Cutting off the forest.	Amount of rainfall.	Destruction of the forests.	Any change is due to the clearing of the forest.
3. . . .	Mountainous regions.	Country is generally hilly.	Hilly and mountainous.	Hilly and mountainous.	.....	Mostly hilly or mountainous.
4. . . .	Considerable forest growth.	Some streams reach back into the primitive forest.	Much.	Little at present.	All gone.	Considerable forest along the tributaries.
5. . . .	No.	None here are using steam.	.....	I do not.	Steam has taken the place of water power.	No, sir.
6. . . .	On increase of business steam is used.	Some mills use steam largely, owing to low water in summer.	Koons Bros. mill run by water at one time, now runs by steam.	.....	Neither; the lumberman's occupation is gone.	Cannot say.
7. . . .	Springs are as strong as ever around here.	Most of the springs are good yet.	By increase of business.	I know of springs that are now practically dry.	Multitudes of them all through the mountain region.	Yes.
8. . . .	Clearing of land producing change is now abandoned.	Clearing the timber and cultivation produces all the change noticeable.	.....	.....	Woods succeeded by brush and briars.	Owing to the coal miners cutting off the supply.
	H. E. E. Roeder. Henschel.	M. B. Trescott, Harveyville.	Clarence Taylor, Harveyville.	Edwin Shortz, Wilkes-Barre.	Garick M. Harding, Wilkes-Barre.	J. Bennett Sweet, Kingston.

Lycoming.	Lycoming.	Lycoming.	McKean.	Mercer.	Mifflin.
1. . . . Muncy Creek.	West Branch. Loyalsock Creek. Lycoming Creek.	Muncy Creek. Glade Run.	Kendall Creek. Foster Brook. Bolliver Brook. Bennett Brook.	Big Sandy Creek.	No.
2. . . . Clearing out of timber tracts and evapora- tion.	Destruction of the for- est.	Removal of timber and clearing the adjacent lands.	Formerly these streams were heavily timbered which has been cut away.	Cutting off the timber bordering on the stream.	
3. . . . Mostly hilly; part level.	Hilly or mountainous.	Mountainous and hilly.	They flow through a hilly country.	30 miles level; 16 miles hilly.	
4. . . . Very little now.	All have been lumbered over extensively.	Much forest growth re- maining on the creek; very little on the run.	Have had much forest growth which has been generally cut away.	But little.	
5. . . . Mills during summer months can not be run by water.	No.	I know mills that are compelled to shut down for want of water.	Water mills have dis- appeared with the pine and hemlock.	Mills formerly supplied with water all the year can now run only one-half the time.	Mann's Axe Factory which extended the works.
6. . . . Failure of water.			Mills are located now near the heads of the streams.	Failure of water.	Increase of business.
7. . . . No.	Several in Armstrong county.	Yes.	I know of some which now go nearly dry in summer.	I know of a number.	No.
8. . . .	Removal of the timber.	Timber has been re- moved.	Mostly caused by loss of timber.	Land cleared up; tim- ber gone; produced the change.	
W. E. Ritter, Williams- port.	O. C. Nichols, Wil- liamsport.	Geo. G. Wood, Muncy.	Albert De Goller, 28 Kennedy st., Brad- ford.	I. H. Robb, Sandy Lake.	J. M. Woods, Lewis- town.

	Mifflin.	Mifflin.	Mifflin.	Monroe.	Montgomery.	Montgomery.
1.	I cannot.	Kishacoquillas Creek has changed wonderfully in the last 50 years.	Kishacoquillas Creek continues about the same.	Brodhead Creek.	Pennepack and its branches.	Parklomen North East Branch. Indian Creek. Skippack.
2.	Removal of the heavy timber along the line of the stream.	Where the trees are cut off there is a decrease of water.	Deforesting its watershed.	I can give no reason for the change.	Have noticed the great change in the quantity of water.	Have noticed the great change in the quantity of water.
3.	Mostly rolling and hilly.	The creek flows through level, hilly and mountainous land.	Mountainous.	Generally level with small hills.	Flow through a level or moderately uneven country.	Flow through a level or moderately uneven country.
4.	Considerable forest growth about the headwaters.	None worth naming.	Some have much; others have little.	Not much now; formerly heavily timbered.	Very little forest growth either at their heads or along their sides.	Not much forest any more, as there was 30 years ago.
5.	I know of two that now require steam part of the time.	All the old mills are greatly at a loss for water in the dry season.	Steam has been added to only one mill on the creek.	Steam has not been introduced, but the mills can run only a part of the time.	Mills formerly run by water now run by steam.	Several mills have both steam and water.
6.	Increase of business only.	To supply the failure of water.	By the increasing of business.	Failure of the water supply.	Business increased; water power diminished.	Steam is required for increase of business.
7.	I do not.	I know of springs which scarcely flow now in a hot season.	Some springs where the trees have been cut away, now go dry at times.	Yes, several.	There are many such springs that come dry in dry seasons.	Yes; along the small streams named.
8.	Scarcely any woodland is left.	Woodland cut away allows the springs to dry up in summer.	Almost all the surrounding country has been denuded of trees.	The woods have mostly been cleared.	The country is farm land, well cultivated, and bare of trees.	The country is farm land, well cultivated, and bare of trees.
Miles Hafty, Belleville.	J. P. Taylor, Reedsville.	J. H. McClintick, Belleville.	R. P. Scharz, Anabrink.	J. B. Goentner, Willow Grove.	H. G. Groff, Halleyville.	

Montgomery.	Montour.	Montour.	Montour.	Northampton.	Northampton.
1. . . . Yes; many.	Chillicothe Creek, West Branch of the Susquehanna water has increased.	The Chillicothe is much stronger than it was 20 years ago.	Mahoning Creek.	Delaware and Bushkill rivers.	
2. . . . Scarcity of wooded land.	Due to land being largely under drainage along the stream.	Due to under drains which have been made along the stream.	To the cutting of timber.	By clearing away the forests along the stream.	
3. . . . Hilly and undulating.	Level.	Level.	Through a valley.	Mountainous country.	
4. . . . But little in most cases.	A little.	Little.	A great deal.	Not as much as in former years.	
5. . . . Can name mills by the dozen that answer this question.	Mill at Washingtonville now run by steam.	At Washingtonville steam in part.	P. F. Man's; John Benfield's.	I do not.	I do not now; steam has been added in some cases.
6. . . . Failure of the water supply.	Increase of business and additional machinery.	Increase of business and machinery.	Failure of water supply.		Mostly to increase of business.
7. . . . Yes.	No.			I do not.	No.
8. . . . Either without woodland, or the land has been cleared.					
B. W. Dambly, Skip-pack.	Dr. J. T. Hoffa, Washingtonville.	H. C. Snyder, Washingtonville.	John K. Gerlinger, Danville.	Chas. B. Zulick, Easton.	H. S. Knecht, Easton.



(Plate 22. See page 46.)

Long Run, Clinton County. Axe and Fire have Removed Most of the Timber. This Valley Characterized by Very High and Very Low Stages of Water.

	Northampton.	Northumberland.	Philadelphia.	Pike.	Potter.
1. . . .	All the streams in the county show this.	Shamokin Creek.	Schuylkill River and many smaller streams.	Wallenpaupack River, Bushkill Creek, Sawkill Creek, Shohola Creek.	There has been a great change in the streams of the county.
2. . . .	Removal of all the large timber tracts of the county.	Mining.	A greater amount of contiguous land being cultivated or diversion of the water.	Cutting away the timber, or destroying it by fire.	Can conjecture no cause but the cutting away of the timber.
3. . . .	Generally hilly.	Hilly.	Mostly hilly.	Hilly and mountainous.	Hilly and mountainous.
4. . . .	Very little now.	Has been cut out off.	Of this I know little.	Not much now; once well timbered.	Some forest growth yet but gradually growing less.
5. . . .	All the mills on the Lehigh and Bushkill now use auxiliary power.	Not any.	No.	Quite a number of mills now use steam as water is wanting.	I know many such mills.
6. . . .	Both in most cases.			Failure of water.	Failure of adequate water supply.
7. . . .	Many.	Yes; and the mines have cut them off.		Many now falling that once were never falling.	Yes; many of them.
8. . . .	Have heard of no other cause than clearing the woodlands.	Cutting off the forest and mining.		The woodland has been cut away.	Gradually cutting the timber off for cleared farms.
	E. H. Leubach, Northampton.	R. F. Nicholson, Shamokin.	Wm. Nickell, 1706 Oxford street, Philadelphia.	John A. Kipp, Milford.	A. G. Olmstead, Condersport.

Northampton.	Schuylkill.	Schuylkill.	Schuylkill.	Schuylkill.	Schuylkill.
1. Yes.	Schuylkill River. Mine Hill.	All the streams in the county.	Little Schuylkill.	Both branches of the Schuylkill River are smaller than former- ly.	Big Swatara. Little Swatara, have less- ened their flow of water.
2.	Removal of timber and mining coal.	Principally mining and scarcity of timber.	Destruction of the tim- ber on the mountains.	Mining of coal and de- struction of the for- ests.	Cutting down the forest.
3. Through a valley.	Through a mountainous region.	Level, hilly, mountain- ous.	Mountainous.	Generally a hilly coun- try.	Hilly and mountainous country.
4. Has no forest near the stream.	Very little has been re- moved through min- ing operation.	Very little.	Very little.	No forest growth, but a fine growth of small timber 5 to 15 feet high.	Very little now.
5.	Pottsville mill now runs by steam; the stream filled with coal dirt.	Such cases are very numerous.		None.	For want of water, mills either shut down in summer or run by steam.
6.	Possibly by both, to avoid annoyances from coal dirt filling.	By failure of the wa- ter supply.			For both causes.
7.	No.	There are a number of such.	Yes; feeders of the Schuylkill.	Many such are reported.	Quite a number in and around our town.
8.		Hilly or mountainous, without much wood- land.	Rocks; timber has all been removed.		Mountainous and hilly; mostly cleared along hills and valleys.
11. J. T. Schwelitzer, Butztown.	O. P. Bechtel, Pottis- ville.	Geo. W. Kennedy, Pottsville.	W. T. Folweller, Ta- manqua.	John H. Strauch, 1100 Mahantango street, Pottsville.	Ed. T. Filbert, Pine Grove.

	Schuylkill.	Schuylkill.	Schuylkill.	Schuylkill.	Schuylkill.	Somerset.	Sullivan.
1. . . .	All the streams in four or five counties.	Catawissa Creek. Lost Creek. Raven's Run.	None.	None.	Mahanoy Creek.	Casselman River.	All the streams in this county are diminishing in volume.
2. . . .	Removing the timber from the headwaters of these streams.	Cutting down the forest at the headwaters of the streams.	.....	.....	Mining operations and clearing the hills and mountains.	The hills are being denuded of their timber.	Removing the timber from the surrounding country.
3. . . .	Mountainous, with areas of level ground.	Mountainous.	Level.	Level.	Both.	Hilly and mountainous.	Hilly, level and mountainous.
4. . . .	But little at present.	A fine second growth is coming on.	Yes.	Yes.	None; all cut down.	Once heavily timbered. The timber has been mostly cut.	We have removed the timber, which was a dense forest.
5. . . .	Many saw mills now run at intervals that formerly run continuously.	Several mills have not water power sufficient but have substituted steam.	Two mills once run by water now use steam during dry seasons.	Two mills once run by water now use steam during dry seasons.	No power; bed of streams fill up with culm.	Mills of John Schultz and Solomon Bittner.	Several mills that run by water now run by steam.
6. . . .	No steam used.	.....	Steam is required to run more regularly during the dry season.	Steam is required to run more regularly during the dry season.	Failure of the water supply.	Failure of water supply.	By failure of water.
7. . . .	.....	No.	None.	None.	.....	No.	One spring, that immediately went dry after the removal of the timber.
8. . . .	.....	.....	.....	.....	.....	.....	A heavy growth of brush has sprung up and the spring is improving.
	A. J. Womelsdorf, Pottsville.	E. C. Wagner, Girardville.	Wm. Schwalen, Valley View.	John X. Dence, Ashland.	J. C. Lowry, Somerset.	G. W. Kipp & Co., Newell.	

	Susquehanna.	Susquehanna.	Union.	Union.	Union.	Union.
1. . . .	A tributary of the Lackawanna where trout were once plenty; now often entirely dry.	Can't say the flow is less than formerly, but more irregular.	I can not.	Laurel Run and Penn's Creek.	Penn's Creek. Laurel Run. Warrior's Run.	Streams are subject to higher floods than 50 years ago.
2. . . .	Clearing of the surrounding land.	Clearing away the forests and leveling the ground	.....	Quantity decreased one-half in 20 years.	Principally to excessive rainfall; partly to clearing out the timber.	Longer continued rains than in former times.
3. . . .	Hilly.	Mostly hilly country.	Mountainous and hilly.	Clearing out the forest in the vicinity.	Partly level valley land; partly mountainous.	Comparatively level country.
4. . . .	Little.	Very little or no forest.	Saplings and undergrowth mainly.	Mostly mountainous, but some level land.	.....	Have a considerable growth about their upper causes.
5. . . .	Nichols Tannery was changed from water to steam at great expense.	Thirty years ago steam mills were scarce, now none run wholly with water.	I know of none such.	Matz mill, Lincoln's mill, other small mills.	Some run by steam now that 50 years ago had sufficient water.	Several such mills use steam during the period of dry weather.
6. . . .	Failure of water.	Increase of business and irregularity of water supply.	.....	Irregularity of water supply.	Partly by both, but largely by the irregularity of the water supply.	Increase of business more than a failure of water.
7. . . .	Yes.	Plenty of springs dry where the land is cleared.	I do not.	Have heard of such, but can't place them.	I do not.	Have heard of such springs, but can't locate them.
8. . . .	Wholly owing to the clearing of the land.	Clearing the land dries all but the strongest springs.	.....	Cannot tell.	.....	Change has occurred since the woods have been cleared.
	Philo Burritt, Uniondale.	James Rooney, West Auburn.	Calvin M. Hayes, Hartleton.	W. E. Smith, Millmont.	Hubley D. Albright, Laurelton.	R. V. B. Lincoln, Laurelton.

	Union.	Union.	Union.	Warren.	Washington.	Washington.
1. . . .	White Deer Creek.	In our mountain streams the water comes out more quickly after rains.	Spring Run; West Branch; during the floods.	Can't name them, but know they decrease.	Have no large streams in our county.	Peter's Creek. Piney Fork. Lick Run.
2. . . .	Due to the cutting away the timber on the mountains.	Destruction of forests and the making of logging roads.	Cutting the timber from the hill sides.	Clearing the woods along the same.	Cultivation of a larger area of land.	Destruction of the forest.
3. . . .	Mountainous.	Hilly. mountainous sections almost all ways.	Both.	All.	Hilly country, with valleys a mile in width.	Hilly.
4. . . .	The great forests of pine and hemlock are nearly all cut away.	Much small forest growth, except for destruction by fires.	Little among the headers of Spring Run.	In some instances.	Little.	Timber nearly cut down.
5. . . .	White Deer Flouring Mills.	None here.	.....	Yes; but can't locate them.	Several mills use steam where they formerly used water.	All the mills on these streams have been abandoned, except one.
6. . . .	Both.	.....	Failure of water supply and competition.	Timber along the streams has been cut away.	Failure of the water supply.	Entirely by failure of water power.
7. . . .	Yes.	There are a few in this section that get dry.	Yes; on our farm.	Know some whose volume has greatly decreased.	Yes.	No.
8. . . .	Dense growth of small timber around the springs in the mountains.	Small growth of timber.	No woodlands at all; never went dry when the hills were covered.	Can't say what produced the change.	Not so much woodland.	.....
	Cyrus Leinbach, White Deer.	S. W. Rutherford, Laurelton.	A. M. S. Potter, lock box 476, Lewisburg.	C. C. Thompson, Warren.	J. H. McIvalise, Washington.	D. M. Anderson, Veneta.

Washington.	Wayne.	Wayne.	Wayne.	Wayne.
1. . . . Cross Creek.	All in this county.	Our streams have changed materially since 1885.	Nearly all the streams in our vicinity.	Can not say there has been any change of them by my own knowledge.
2. . . . Change due to the destruction of the forests.	Clearing up of the country.	Clearing the land of forests.	Cutting off the timber and clearing the land.	Original growth of timber having been destroyed along the hill-sides.
3. . . . Hilly.	Hilly.	Hilly; sometimes most mountainous.	Quite hilly; streams rise quick after a rain.	Hilly.
4. . . . Probably 15 per cent.	Very little.	Originally much hemlock, now brush and second growth.	But little left; now fires have killed the small growth.	The heavy forests of hemlock have been entirely destroyed.
5. . . . Two mills in part and 13 old mills entirely abandoned.	Kimbles, Gleason's and Stanton's.	Kimble's twomills; one runs by steam, the other falling down.	My own used to run by water, now only by steam.	Tanneries first built to run by water then by steam are all gone.
6. . . . Failure of water supply.	Failure of the water supply.	Failure of water supply.	Failure of the water supply.	Failure of the water supply, [and also failure of bark. J. T. H.]
7. . . . Some formerly strong springs are visably weakened.	No.	Many such; some of the best get very low.	Plenty of them.	There are many that become dry in dry seasons.
8. . . . Denduing the country has decreased the volume of water.	No.	When the country was a dense forest the springs rarely failed.	Were in heavy timber; now in meadow land.	Original growth has been cut off; a second growth has sprung up.
Jas. Simpson, Cross Creek village.	John Kuhback, residence.	Theodore Day, Dyberry.	Joel G. Hill, Look Out.	L. S. Collins, Honesdale.

	Wayne.	Wayne.	Wayne.	Wayne.	Westmoreland.	Westmoreland.
1. . . .	Middle Creek water power is much less than formerly.	Quantity of water carried is much less in all the streams I know.	Have detected no change in 40 years in the numerous streams.	Lehigh River has just as much water, but it passes away more quickly.	In Mill Creek there has been a decrease in the volume of water.	Jacob's Creek. Rough River. Sewickly Creek.
2. . . .	To clearing the land from timber which causes the water to dry up.	Timber being cut and the sun absorbing the moisture.	Changes originate in the amount of snow and water fall.	Cutting off the timber at the head waters.	To forest fires.	Because of the cutting down of the timber.
3. . . .	Hilly country.	Mostly hilly country.	Mostly hilly and mountainous.	Table land comparatively level.	Mountainous.	Some through mountains and others through level lands.
4. . . .	Not as much as there used to be.	Very little.	Much.	Considerable second growth where the fire has not destroyed it.	Considerable.	Very little forest growth at the headwaters of any of the streams.
5. . . .	Kelser's Flouring Mill on Middle Creek.	Middle Creek mills require steam nearly one-half the time.	Do not know any.	There are no mills abandoned for want of water.	The Springfield mills in Ligonier township.	I know of none that I run by water alone.
6. . . .	Failure of water supply.	Failure of the water supply.	Increase of business only in those I know.	.....	By both.	In nearly all cases failure of the water supply.
7. . . .	One less than 40 rods from my house.	I do.	I do not believe we have any such springs.	Yes.	No.	Yes; quite a number.
8. . . .	Think that clearing of the land was the cause.	Timber all cut, land cleared, moisture dried up by the sun.	.....	Nothing but a second growth around them now.	.....	Cutting and clearing the timber brought about the result.
	Paul Swingle, South Canaan.	W. N. Curtis, South Canaan.	W. M. Nelson, Equinunk.	R. C. Drüm, Thorns-hurst.	S. D. Murphy, Ligonier.	W. Newton Porter, Scott Dale.

	Wyoming.	York.	York.	York.	York.	York.
1. . . .	All the streams located in the county.	The streams carry as much water as at any time.	Don't know any streams that have changed in the quantity of water.	Not certainly. The Cordus is said to carry less water.	No, sir.	Cabin Run used to furnish power for four mills, now two run by steam.
2. . . .	Cutting down the forest.	I claim water was kept back by leaves, when it was scarce.	In some seasons there is more rain than in others, which causes the change.	Probably to greatly increased consumption in York, which is supplied by this stream.	.....	Cutting off the forests and clearing away the glades.
3. . . .	Mountainous.	Hilly.	Through hilly or rolling country.	Level.	Most flow through a hilly country.	Mostly rise in rough and hilly sections.
4. . . .	But little of the original forest left.	.....	Not much forest growth about their headwaters.	Not much.	Little forest growth among the headwaters.	Formerly they were densely shaded with oak, now mostly cleared away.
5. . . .	None.	Yes; but is due to increase of machines which require more water.	I know two mills run by water now run partly by steam.	Several mills within 3 or 4 miles of the city of York.	One mill runs partly by steam; water supply not strong enough.	Nearly all the mills have had to add steam to their power.
6. . . .	No.	Steam required by increase of business.	Steam is required by increase of business and use of additional machinery.	Large increase of business and change of methods.	Increase of business requires steam.	Increase of business and lack of water power.
7. . . .	No.	No.	Don't know of any springs that have changed in this respect.	No.	No, sir.	I have three such on my farm. It is a subject of remark.
8. . . .	.....	.....	Know springs that have failed because wells were sunk beside them.	.....	About one-eighth woodland; the rest cleared land.	In every case there is less woodland and shade than there was.
	Frank H. Pratt, Tunkhannock.	H. M. Bortner, Glenville, miller for fifty years.	J. Finney Gibson, Bryansville.	Jas. W. Latimer, York.	D. Sterling Metzel, Wintersetown.	Gerard C. Brown, Yorkana.

York.	York.	York.	York.	York.	York.
1. Codorus. Buffalo Valley. Stine's Stream.	There is a great difference in the streams here.	Branches of the Codorus and of the Deer Creek.	Codorus and its branches.	Logwood Run.	Muddy Creek; flow of water is certainly much less.
2. Irregular rainfall caused by devastation of our forests.	To timber being cut away in almost all cases.	Due to the destruction of the forests.	To the clearing away of the timber.	Destruction of the forest at its source.	Clearing away the forests at the sources of supply.
3. They flow through hilly country.	Some in hilly, others in level land.	Mostly rolling ground, some places hilly, but not mountainous.	Hilly country.	Mountainous and hilly country.	It flows through a hilly country.
4. Very little on the headwaters of these streams.	Not at the present.	There is very little forest growth about the headwaters of these streams.	Considerable growth, but 50 per cent. less than 50 years ago.	There was much; now one-half cut off.	There is little forest growth about its headwaters.
5. Heindell's, Snyder's, Kraft's and Buffalo mills and Codorus mills.	Mill on Cabin Branch requires steam for part of the year.	All the mills in operation have added steam power.	Large number of mills have changed.	Miller's Prosser's and Dick's mills require steam a part of the time.	I know of none such.
6. By both; but mostly from an increase in business.	Steam is necessary on account of low water.	Failure of water.	Largely failure of the water supply.	Failure of the water supply; mills require steam in part.	.....
7. I know of several.	Yes.	There are a number of springs and some wells that have failed.	There are some in which the supply has much diminished.	No.	I do.
8. Change owing to the increased amount of tillable land.	.....	Failure of the springs is owing to the clearing of the land mostly.	The country is laid out in farms and the timber nearly all cleared away.	.....	Character of the country around these springs has not materially changed.
J. W. F. Copenheaver, Codorus.	Benj. Mittel, East Prospect.	E. F. Keller, Shrewsbury.	Samuel Small, York.	Henry M. Fishel, Dillsburg.	S. G. Boyd, York.

If there is a loss of water and water power on the one hand, and an increase in the number and severity of destructive freshets on the other, it may be most pertinently asked, does science offer no remedy?

If this question could be positively answered now for this State by any one, it could be by my accomplished colleague, Mr. Shunk. But every region is a law to itself and requires a minute examination which has been beyond the power of your Commission to give in the time, and with the means allowed. It can only be said that elsewhere the resources of science have been sufficient to ameliorate the conditions indicated.

It would be proper to suggest the following general principles. Mountain streams, such as the most turbulent of ours are known to be, as a rule precipitate their water with great rapidity into the lower valleys in which the larger streams run. It is in these valleys that the largest industrial interests are located and the greatest damage is done. Whatever tends to retard the delivery of water from these valleys, by so much, allows it to accumulate there and to raise the general height of the water. Whatever places the tributaries under control does to that extent enable their waters to be held back until the main channels are in part relieved. In other words, the main channels should be kept clear to facilitate the rapid delivery of the water from the tributaries. On the other hand, the tributary streams should either be held in actual check, or the means provided to do this as required. Now what do we find to be the case? The exact reverse of the desired condition that has been suggested. At least, this is so along the streams where the most disastrous freshets have hitherto occurred. The smaller streams in the lumbering regions have been cleared out that the "running of logs" might be facilitated. The main channels have been obstructed by booms and by dams for various commercial purposes. Whatever may have been the needs of earlier years, it is more than doubtful whether this latter condition is justifiable now. To return to the mountain tributaries. The removal of the forests destroyed the bed of leaves and the accumulation of moss that acted so efficiently as a retaining mass, for the water, over the general surface. The repeated fires have destroyed the decaying organic matter, or left it in such a condition that it remains a poor absorbent of water. In addition to all this, the logs which formerly lay in and across the rivulets and streams have decayed. The maximum of water flows out of the country and the minimum is retained, by absorption, in the ground. (See Plate 24).

If these principles indicate anything, they show the lines along which the process of repair must run. They clearly point to the restoration of our forests on the head waters of our most violent streams; to the erection of retaining barriers where it could be done



(Plate 23. See page 46.)

Dense Tangle of Virgin Forest. Centre County. Stems, Leaves and Roots Aid in Retaining the Water which Falls.

most cheaply and with the best results, and to opening out the main channels of the largest streams. To go beyond this, would be out of my province, and I leave the subject here.

A PRACTICAL MAN'S EXPERIENCE IN TIMBER RESTORATION.

The Commissioner of Forestry has received the following letter, which describes a condition of affairs not only for the region referred to, but also over an alarmingly large portion of the Commonwealth:

"Dear Sir: I was glad to get your valued favor of the 4th inst., with enclosures. My attorney informs me that the Commissioners of counties can, under the law you sent me, only refund the percentage of county tax, which is but a trifle.

"In 1890, seeing the frightful wreck and havoc made, and being made, with the woodlands of the country, especially in Pennsylvania, I bought a tract of some 1,200 acres in Pennsylvania, with the view of putting the same into shape, cultivating and saving every tree possible, so as to show to others what could be done to develop forest growth. This was to be a work of pleasure, without the expectation of making any money. Up to date I have wasted about \$20,000, and got nothing to show for the money, time, labor and trouble expended.

"The great curse of that section is the utter lawlessness which prevails, and the ignorance, crime and stupidity of the small population encamped there, to which poverty might be added. They are opposed to my being there: (1) Because I fenced off some of my land, thus keeping out their cattle, so they stole and carried away some of my fences, and cut the wires of others into small pieces; (2) they set fire to the woods, destroying hundreds of acres of young growth of trees, numbering millions, because I put up notices warning off hunters; (3) they set fire to my cottage, wagon shed and hay shed last fall, so as to force me to leave when winter set in, so they might steal timber unmolested, such as is used for props and lagging in mines; (4) they drove off or demoralized my workmen so as to embarrass my operations and annoy me; (5) they stole my tools, harness and household effects, including meat, flour, etc.

"I complained to the justices and to the district attorney, and to the county detective, but they don't do anything. It is necessary to have some State policeman or detective live in that section, or some game protector. There is no justice of the peace or constable for over twenty miles each way. The courts and juries are opposed to any new wrinkles, preferring the old ways, and won't punish

such offences. The residents of this section laugh at the idea of the law interfering with them, as they say there is no law in that country. I have been among the desperadoes of California, Colorado and the great plains, but they are gentlemen besides the sneak thieves and fire bugs of that section. The stockmen, the hunters and the fishermen are the chief parties needing regulation. If the laws could be so amended as to give the land owner proprietary rights in whatever his land produced, whether it be trees, grass, herbs, birds, fishes, and inflicting heavy penalties, and give damages to owner of three times the value of the property taken, and imprisonment besides—something like the present timber laws—then all sorts of trespassers would be quite rare; and in time we might hope to see a decent growth of timber over the thousands of square miles of what is now desert and waste land.”



(Plate 24. See page 110.)

Hill near Block House Run, Lycoming County. Surface Becoming Barren from Washing Away of Fertile, Surface Soil.

CHAPTER VIII.

THE SUGAR MAPLE.

BY A. C. Sisson.*

The sugar maple, also known as the rock maple, is one of our most valuable trees, and its wood is of very remarkable beauty. Some trees have perfectly straight fibre, which makes the best wooden cog wheels; others have curled or sinuous courses of fibre, and the birds-eye maple has little curls resembling the eye of a bird, and is susceptible of very high polish. It is very valuable and is used in some of the most expensive styles of furniture.

The sugar maple extends from the mountains of Alabama north into Canada, and westward to Kansas and Nebraska. It is most abundant in the New England and Middle States. Soils seem to affect the style of growth so much that there is often a very marked difference in the general shape and appearance of the trees of this variety. When growing in forests it has a tall, straight trunk, often reaching from 80 to 100 feet in height, but in cleared fields and along road sides it has a short thick trunk with massive spreading branches, which form into beautiful globe shaped tops and make one of the most desirable shade trees known. It is hardy, easily transplanted and grows very rapidly, the trunks often measuring twelve to fifteen inches in diameter when twenty years old. The foliage is of a bright green color, smooth on the upper side and of a pale hue beneath. Its autumnal tints are among the most beautiful to be seen in this climate, changing to golden or orange, and sometimes to bright scarlet or crimson. For ornamental purposes, for lawns and parks it has no superior, but its greatest value consists in its abundant flow of sweet sap during the months of February, March and April, from which is made the most delicious syrup and sugar, outrivalling every other known product as a luxury for the table when properly manufactured. The primitive methods adopted by the early settlers, viz: wooden troughs to catch the sap, and cast iron kettles to evaporate it, were imperfect, expensive and uncleanly, and the product bore no resemblance whatever, either in flavor or appearance, to the exquisite nectar that is now produced by the aid of improved machinery. To tap the trees a three-eighth inch bit is used, boring from one to two inches deep. Into the hole a hollow tin spout is driven, upon which perfectly clean covered tin

* By the death of Mr. Sisson, recently, the forest cause has lost a zealous, capable and constant friend.

pails are hung to catch the sap. This cover prevents all rain, snow, insects and other impurities from coming in contact with the sap, which should be collected and evaporated just as soon as possible after it flows from the tree. If left to stand even for a few hours fermentation will commence, which seriously affects the flavor. The annual product of a tree is variable. Mr. C. W. Kellog, of South Duxbury, Vermont, says he has a tree two feet in diameter that makes thirty pounds twelve ounces of small cake sugar in one season. Seven quarts of the sap made a pound of sugar. Sixteen quarts is the common average quantity for a pound. A man in Waitsfield, Vermont, says he made twelve pounds of sugar from one tree in twenty-four hours. He put six spouts in the tree. I have read of trees that produced fifty pounds of sugar in one season from ten or twelve spouts, but these are very remarkable cases. From five to ten pounds is about the average. Evaporators are now made of tin and are from three to four feet in width and from eight to fifteen feet in length, according to the number of trees used. They are set in iron arches arranged so that wood or coal can be burned. The bottoms are made so that there is a continuous stream flowing across from one side to the other from fifteen to twenty-five times, according to the length so that the sap that comes in through an automatic regulator at one end is reduced to syrup by the time it reaches the other and runs out in a continuous stream, fast or slow, in proportion to the amount of fuel used. This regulator is connected with the receiving tank by a rubber hose, and is so arranged that a larger or smaller stream is let in, according to the heat under the evaporator, and it will stop entirely when the fire goes out. There is therefore no danger of burning so long as there is a supply of sap in the feeding tank. To test the weight of syrup, a thermometer is used, which stands in the evaporator near the outlet, and when it indicates 219 degrees it will weigh eleven pounds to the gallon, and is as heavy as can be made without granulating when cold. If soft tub sugar is desired, it should show 238 degrees; if hard cake sugar, 245 degrees. If a saccharometer is used instead of a thermometer, it should show from thirty-two to thirty-three degrees while boiling hot, to make eleven pounds of syrup to the gallon. We prefer the thermometer, which insures a uniform weight and thickness. Syrup thus manufactured will keep perfectly, as long as desired, in air-tight packages. It is usually put up in self-sealing gallon and half gallon tin cans and can be shipped safely any distance. The demand for pure maple sugar and syrup is increasing from year to year, while the supply is steadily decreasing. In many sections the trees are fast going to decay, owing to their great age and improper usage. If intelligent care had been exercised they might have been preserved and their usefulness prolonged for many years. Seventy-five years ago the sugar maples

of Northeastern Pennsylvania were among the finest to be found in any of the states, and produced annually fabulous quantities of sugar and syrup. The owners of the maple forests made a most fatal mistake in trying to give the trees an extra good chance by cutting away all other timber and underbrush to let in the sunlight and give the grass a chance to grow. This they thought would furnish pasture for their stock, and be an additional source of profit. The result was that as soon as the grass got possession of the soil it robbed the trees of the necessary moisture and they ceased to grow and very soon died. They could not adapt themselves to the changed conditions. They had grown all their lives with a heavy coat of decaying foliage over their roots, which invited them near the surface, where moisture and fertility were always found in abundance. Not so with trees that have grown in cleared fields. They send their roots down deep to permanent moisture and make a most vigorous growth. In all maple forests that are designed for sugar making a sufficient amount of underbrush should be permitted to grow to completely cover and shade the ground and furnish a heavy crop of leaves to decay each year and supply the most natural fertilizer for the growing trees. Another serious mistake was made by the early settlers in unmercifully wounding the trees in order to get a large amount of sap. They supposed it was necessary to cut large gashes every year, which soon weakened the trees and caused them to decay to such an extent that many were broken off by severe gales. Had they experimented a little, they would have found that a small auger hole would produce nearly, if not quite, as much sap as the great openings they made, and would not injure the trees in the least.

When the season is over the spouts should be removed and a small brush dipped in some cheap paint should be inserted and the entire surface of the hole covered to prevent decay. In two or three years the wound will heal and no damage result to the tree. There is no industry on the farm that depends so much upon the weather as maple sugar making. The best results are reached when the thermometer falls from ten to fifteen degrees below freezing at night, and rises to fifty or sixty degrees above in the day time. The season for commencing operations is always indicated by the conditions named, and always closes whenever the thermometer ceases to fall below the freezing point, and the new growth of the tree commences, which gives a peculiar, disagreeable buddy flavor to the product. Scrupulous neatness and cleanliness must be observed in all the various operations of sugar and syrup making. One of the most perplexing difficulties that the modern maple sugar maker has to contend with is the belief of his customers that the product is largely adulterated with refined cane sugar. The color and flavor of the pure product are now so unlike what they formerly were, that suspi-

cion is naturally aroused, and they are continually clamoring for the old time "maple flavor." Many a sugar maker has worked at the business all his days, produced and sold thousands of pounds, and yet never had the slightest conception of the really true maple flavor. The peculiar taste that his product had was a mixture of oxygen, partially fermented sap, burnt sugar from the side of his old iron kettle, ashes, smoke and various other impurities too numerous to mention, and people learned to relish this compound, just as they learn to love tobacco. They look with wonder and admiration upon the beautiful refined cane sugar now in use, and are astonished to think how they formerly enjoyed the coarse brown article they were obliged to use before refineries were in fashion; yet they are not willing to admit the possibility of any improvement along the line of maple sugar making, forgetting that this is an age of advancement in arts and sciences.

To the philanthropist, and to all those who would confer a great blessing upon coming generations, we commend the extensive planting of sugar maple trees. There are upon all our farms places where they could be planted without injury to other crops; along the highways and byways, small streams of water, ravines, rocky hill sides, and between farms, where they could soon be utilized as posts for wire line fences. A thousand trees thus planted would in fifteen or twenty years add from three to five thousand dollars to the value of the farm and annually increase the income, besides making it more beautiful and attractive. Seedling trees from one to three years old can be found in great abundance in all maple forests. They can easily be pulled up and placed in nursery rows in rich soil, where they make a rapid growth and soon attain suitable size for permanent planting.

[From *American Agriculturist*, Feb. 29, 1896, page 226.]

THE PRINCIPLES OF MAPLE SUGAR MANUFACTURE—RESULTS OBTAINED AT THE VERMONT EXPERIMENT STATION.

1. An accurate thermometer is the sugar maker's best guide in determining how to handle his syrup to make a sugar.
2. When sap begins to boil, its temperature is about 213 degrees; as it boils down and becomes thicker, the temperature at which it boils rises until, toward the end, it may be 235 degrees to 240 degrees or even as high as 245 degrees.
3. The syrup also contains mineral matter, malate of lime ("nitre" or "sugar sand"), burnt sugar and toward the end of the season various materials resembling glucose, due to the starting of the buds and the beginning of the summer's growth of the tree.

4. These extra materials at the beginning of the season are about one-sixteenth the weight of the sugar, and increase until, in some very poor and black "last run," they may amount to thirty pounds for every 100 pounds of actual sugar present.

5. Hence 100 pounds of a first class syrup boiling at 228 degrees, instead of containing eighty pounds of sugar, contains about seventy-five pounds of sugar and five pounds of the other materials, the other twenty pounds being water.

6. The more the impurities, the higher the temperature to which the syrup will have to be heated.

7. To make a sugar testing eighty by the polariscope, which is the standard of quality, first-run syrup will have to be heated to 233 degrees. The general run of good quality syrup through the most of the season will need to be heated to 235 degrees and if it is a little dark to 236 degrees. Toward the latter part of the season the temperature will need to be raised to 238 degrees, and the same should be done at any time when a syrup gets scorched or for any reason seems to be of poor quality. This is always on supposition that the syrup is stirred until it grains, according to the ordinary custom in Vermont, before it is poured into the tubs or pails. If the malate is not removed, this temperature will need to be raised still higher.

8. A sugar containing ninety per cent. of pure sugar can be made only from the best syrup in the first half of the season. The syrup to make it will have to be heated to 242 degrees.

9. A syrup boiling at 219 degrees has a specific gravity of 1.325 and weighs just eleven pounds to the gallon. This will not granulate under ordinary conditions, but at 220 degrees crystals of sugar will begin to form.

10. A syrup weighing eleven pounds to the gallon will, if of good quality, make eight and three-fourths pounds of sugar testing eighty, or seven and three-fourths pounds of sugar testing ninety degrees.

100 Pounds Syrup Weighing 11 Pounds per Gallon, sugared off.	Weight of Sugar, Pounds.		
	Average.	Lowest.	Highest.
At 232 degrees will yield,	82.7	82.0	83.3
At 234 degrees will yield,	81.2	80.0	81.9
At 236 degrees will yield,	80.5	79.5	81.1
At 238 degrees will yield,	79.5	78.5	80.7
At 240 degrees will yield,	78.7	78.2	79.7
At 242 degrees will yield,	78.1	77.4	78.9

CHAPTER IX.

CHARCOAL INDUSTRY.

Philadelphia, July 24, 1894.

Dr. J. T. Rothrock, Forestry Commissioner, Harrisburg, Pa.:

Dear Sir: As requested I send you the following data concerning some of the forest areas which have been, or are now held by those interested in the production of charcoal iron; either as pig metal or as blooms. It has been impracticable to obtain complete information concerning these woodlands, because so many of the tracts have changed ownership or been divided, but as will appear in a subsequent statement I have been able to collect records of large acreages held by charcoal iron works now on the active list, or which have been maintained in order to furnish wood for charcoal production. Notwithstanding the heavy demands made by this industry, Pennsylvania is undoubtedly indebted to the charcoal iron works for a large portion of the forests which are spared. These are not however, the magnificent groves of half a century ago—but rather considerable areas of coppice or small growths of timber, yet they serve a good purpose in possibly influencing the climate and water supply of adjacent territories.

A proper introduction to the subject may be a statistical statement of the number of charcoal blast furnaces and forges, and their product as reported in a series of years, and such a statement collected from the various reports and directories published by Mr. James M. Swank, general manager of the American Iron and Steel Association is herewith presented in connection with an estimate, giving the approximate consumption of charcoal in the production of the metal in every year.

A retrospect for two decades has been selected as sufficient to show the demands made upon the timbered areas in late years, and to indicate the number of enterprises which within twenty years were dependent upon a permanent cord wood supply.

STATISTICS OF THE PENNSYLVANIA CHARCOAL IRON INDUSTRY 1874-1893.

Years.	Number of charcoal blast furnaces.†	Net tons of pig iron made.	Number of forges and bloomeries.‡	Net tons of blooms and billets.	Approximate consumption of charcoal in blast furnaces and forges. Bushels.
1874.....	40	40,978	39	19,000*	6,067,860
1875.....	39	34,491	38	19,032	5,280,840
1876.....	39	23,099	39	13,401	3,575,940
1877.....	38	29,636	39	16,517	4,547,840
1878.....	37	29,380	36	16,121	4,430,460
1879.....	37	35,895	36	23,956	5,755,560
1880.....	37	49,874	37	24,319	6,664,020
1881.....	37	51,908	37	28,342	7,929,380
1882.....	36	49,075	34	20,406	7,761,480
1883.....	36	38,315	34	29,408	6,289,200
1884.....	32	28,155	33	19,922	3,746,570
1885.....	32	12,148	33	16,462	2,864,000
1886.....	24	16,727	25	20,536	3,060,130
1887.....	20	11,910	21	21,932	2,639,020
1888.....	20	15,130	21	19,031	2,310,150
1889.....	16	16,951	15	18,504	2,364,850
1890.....	15	18,273	14	16,606	3,006,940
1891.....	15	11,819	14	15,256	2,215,380
1892.....	15	13,227	14	4,173	1,705,350
1893.....	14	6,150			

* Estimated.

† Only collected on alternate years.

As most of the statistics of the American Iron and Steel Association are given in net tons of 2,000 pounds, this has been used in the above table instead of the commercial or gross tons of 2,240 pounds.

Had the inquiry extended further it would have shown that half a century ago all of the iron produced or wrought relied upon the forests for fuel and consequently the iron works were scattered throughout the State denuding the woodlands. With this growth of the use of mineral fuel the employment of vegetable fuel has decreased and to-day but a small portion of the iron industry of the State employs charcoal or wood.

This statement demonstrates that the number of blast furnaces and bloomery or forge fires has greatly decreased. Improved practice has made it possible to produce a given quantity of pig iron in a smaller number of blast furnaces than formerly, and economies in operation have greatly reduced the consumption of charcoal per ton of product. The number of blast furnaces and bloomeries given in the table represent the plants considered as in condition to operate at each edition of the directory, a portion only of which are simultaneously active. Thus on December 31, 1893, only two furnaces out of fourteen were active, on December 31, 1891, four out of fifteen were in operation, on December 31, 1890, six out of fifteen were in blast, etc. For the purpose of the present inquiry however, the extent rather than the capacity of the industry is important, for as a rule, each blast furnace and bloomery was connected with tracts of woodland, which were maintained and guarded so as to insure a permanent supply of charcoal. In a number of cases where operations have been abandoned at bloomery or furnace the timber lands have been retained in whole, or in part and form an important

feature of the continuous forest area of the State. The industries which still remain active have probably added as much woodland as has been cleared for farms, so that these may be considered as maintaining large forest areas.

Improvements in charcoal production have not been as marked in Pennsylvania as in some other sections, the use of kilns being proportionately less than in most of the other states making charcoal iron, hence the yield of charcoal is below the average, but it is probably equitable to allow three cords of wood for each 100 bushels of charcoal for the past decade, and three and one-half cords per hundred bushels for the previous ten years. Estimating an average yield of thirty cords of wood per acre the quantity of land annually denuded may be calculated. But as twenty-five years may be considered a fair cycle of rotation in Pennsylvania, it was necessary for the charcoal iron works to maintain in timber at least twenty-five times as much land as was annually cut over. With a desire to equalize the cost of production during a term of years, the "wood jobs" as the clearings were termed, were scattered each season to give an average haul to the works; thus securing to some extent such an alteration of timber, coppice and sprouts, as best encouraged the propagation of forest growth and maintained climatic equilibrium.

The large areas of woodlands in the State principally in mountainous regions owned or controlled by the proprietors of charcoal iron works may prove valuable nuclei for systems of reforestation. and if those who direct the cutting of these forests adopt systematic methods of reproduction, the increased outlay in caring for this new growth would bear good interest at the maturity of the trees, by securing timber of greater intrinsic value than would otherwise grow under existing conditions; and this could be accomplished while the supply of fuel was maintained. Thus the existing charcoal iron works would become true conservators of the forests; and the practice of careful reforestation would encourage owners of woodland in general to investigate the merits of forest culture, resulting in similar care being bestowed upon other forest tracts or in trees being grown upon ground which is now barren or which does not produce paying crops. If those who own or control extensive forest areas appreciate the benefits which may confidently be expected from careful selection, thinning and protection of growing forests, both as regards the physical and financial effects, the extent of forest in the State will be increased rather than diminished. This would naturally point towards the cordial support of any judicious movement in the interest of forestry from those engaged in the production of charcoal, or who control the lands formerly connected with those industries when active, an end greatly to be desired, for while it will benefit the community at large, its best results will favor the charcoal producer.

In this respect there has been a marked difference between the practice followed in the lumber industry and that devoted to charcoal iron, the former cutting over a tract and abandoning it, the latter protecting and encouraging new growth. While the forest fire ravages in Pennsylvania have been very great, they would have been more severe had it not been for the exertions of those who operated charcoal iron works; in fact, with occasional exceptions, where farm buildings, fences or settlements were in immediate jeopardy, the only efforts made to check or extinguish forest fires were made by employes of charcoal iron works. At most of the blast furnaces or bloomeries the workmen were organized to fight fire, and when an alarm was given all who could be spared were sent out to endeavor to control the flames, not only on the property connected with the works, but upon contiguous land. In some instances all work was stopped and the entire available force spent days fighting the fire back, at the expense of the proprietors of the iron works. Only those who have taken part in this exhaustive work, or who have made up the cost sheets for fighting forest fires can appreciate the sacrifices made to decrease the damage done, for although this action was due to what may be considered selfish motives of protecting wood supply for the iron works the entire community shared in the ultimate advantage. Often it has been necessary to maintain a cordon of men facing a fire along the mountain crests or slopes extending for distances of ten miles or more.

The maximum demand for charcoal for iron production was, as shown by the table about eight million bushels, to which may be added the consumption of this fuel for other purposes; it is therefore probable that as much as two and a half million cords of wood have in one year been cut for charcoal production, clearing an area of probably 100,000 acres.

A considerable industry of which no account is taken in this report, exists in Northern Pennsylvania and Southern New York with Binghamton, New York, as a business center. Here numerous resorts are used to carbonize wood, the resultant vapors being condensed and utilized to produce commercial acetates, methylic alcohol and wood tar, the charcoal being sold as a by-product principally in Pennsylvania, New York and Connecticut for blast furnaces.

Information has been sought among those known to be connected with forest areas which were maintained for charcoal iron works, and data concerning twenty of these have been collected by answers to a series of queries. These queries are given below with a synopsis of the answers received:

Query 1. How many acres of woodland have you in Pennsylvania?

Answers showed that these twenty iron works had tracts of timber connected with their operation varying in size from 25 to 38,000 acres with a total aggregate of 166,133 acres, or nearly 260 square miles.

Query 2. In what counties is this woodland located?

The data presented showed that this timber was in the counties of Adams, Berks, Cameron, Centre, Cumberland, Chester, Dauphin, Elk, Franklin, Huntingdon, Lancaster, Lebanon, Mifflin, Perry, Schuylkill and Union. Unfortunately where the woodland belonging to some companies was located in more than one county, the amounts in the different counties were not given, but speaking generally the works reporting had the greater portion of their lands in Franklin, Adams, Cumberland, Mifflin, Huntingdon and Centre counties (see Appendix).

Query 3. Do you aim to maintain this quantity by encouraging new growth on the territory cut over?

All the various companies answering stated that they encouraged new growth, some of the wood being second, third and even fourth growth.

Query 4. Under normal business conditions what number of acres are annually cleared?

This varied from nothing where the furnace or bloomery was idle to 1,000 acres per year.

Query 5. Are organized efforts made to check forest fires?

Every operation stated that the forest fires were fought, generally by their own employes, but one furnace manager stated that he paid "very little attention to forest fires." The majority, however, used every effort to put them out "regardless of cost" as one works expressed it.

Query 6. Do you receive any assistance in combating forest fires from county commissioners or other officials, who by law are directed to do this?

With but two exceptions all the companies reported that they received no assistance from the counties, although one works said, that this had been demanded but not given. One operation in Franklin county stated that it received such assistance since the enactment of the law which included Franklin county as one of those entitled to receive it, while still another in Berks county, reported that there was a fire commission appointed, but in case of forest fires it "was not of much account."

Query 7. Do you systematically reforest denuded areas, plant or propagate new growths of trees?

In reply to this question it was found that in no instance were new trees planted, after the land had been cut over. It was the universal custom merely to keep out cattle, guard against forest fires, and in this way allow the natural growth of sprouts to reforest the denuded areas. Mr. William M. Potts, manager of the Isabella Furnace, at Wyebrooke, Pa., in writing of this, states that a visit to that section of the country which has had charcoal furnaces in operation for considerably over a hundred years would demonstrate the correctness of the claim that the charcoal iron industry maintains forest area.

He says further that "Our experience is, that all of the woods we use for charcoal, namely: chestnut, oak, beech, birch and maple will immediately begin to reforest, after being cut, if fire and cattle are kept away. In the eastern counties we do not have much trouble from these two causes, but in the western counties the people have convinced themselves that the ground will not reforest and are therefore extremely careless about starting forest fires, and let their cattle feed on the young trees. We can show you in Elk county, a large area which was cut off in 1886-7, and which has been preserved from fires and cattle, which now has a dense growth of beech, birch and maple on it, from eight to twelve feet in height while just across the valley from this tract is another lot which was cut in 1881-2, which has suffered from both fire and cattle, which is just beginning to reforest."

The fires come chiefly from two causes:

1st. The railroad companies burn their old ties along the right of way, without taking any precautions to prevent the fire spreading to the woods, and

2d. The small farmers in clearing wood lots for farming purposes burn the brush and fallen timber, without caring whether the fire spreads or not.

"The cattle difficulty can only be overcome by compelling owners of stock to keep it off of the sprout land."

The foregoing is presented as the best information which I can supply with the facilities at hand, a more thorough and systematic inquiry would add to the number of acres embraced in properties which were, or are connected with charcoal iron works. In addition the possibility of supplying wood or charcoal encouraged owners of neighboring properties to maintain a greater proportion of their lands as forests, much of which is still preserved.

If I can supplement the data offered by additional information please advise me.

Yours truly,
JNO. BIRKENBINE.

APPENDIX "A."

In the absence of actual data concerning the location of woodlands I ventured no absolute division of the areas by counties, but from the reports received supplemented by personal knowledge of many of the properties the following approximations are presented. The figures however, only refer to the properties whose ownership is known and will be augmented in a number of cases.

**APPROXIMATE AREAS OF FOREST MAINTAINED IN CONNECTION WITH CHAR-
COAL IRON PROPERTIES.**

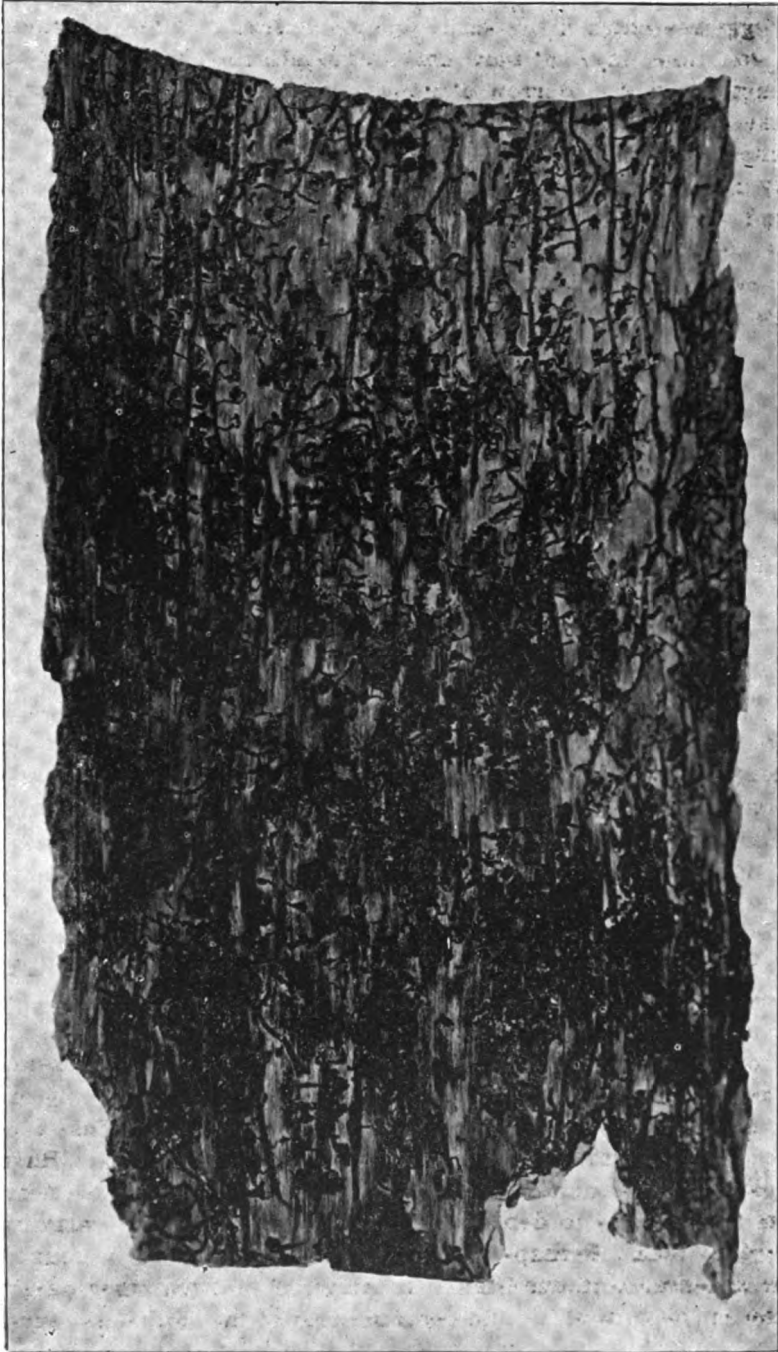
Counties.	Acres.
Adams,	12,000
Berks,	7,363
Cameron,	8,000
Centre,	19,000
Chester,	1,250
Cumberland,	28,500
Dauphin,	1,000
Elk,	6,000
Franklin,	29,720
Huntingdon,	25,000
Lancaster,	4,900
Lebanon,	4,200
Mifflin,	13,000
Perry,	2,000
Schuylkill,	3,500
Union,	500
 Total,	 165,933

DESTRUCTION OF THE PITCH PINE FORESTS OF PENNSYLVANIA BY THE "PINE-BARK BEETLE."

In October, 1893, in company with Dr. J. T. Rothrock, I visited Fulton county to examine into the destruction wrought by insects in the pitch pine forests of that locality. Most of the damage had been done in the southern part of the county, where numerous patches of forest, sometimes several acres in extent, were found to be seriously damaged. The destruction of pitch pine trees by insects was first observed in the summer of 1891. In 1892 the havoc was very great. This year (1894) it has been less. Along Sideling Hill, near Needmore, on the property of Mr. George F. Smith, several acres of pine forest have been destroyed by insects. We noticed one tree that had commenced to die at the top, and were informed that most of them died in this way. An examination showed that the upper half had been attacked by the "pine-bark beetle" (*Tomicus cacographus* Lec.). This insect belongs to the family Scolytidae, and is one of the beetles that have been so destructive to the pine forests of West Virginia. These insects are being ably and thoroughly studied by Mr. A. D. Hopkins, of the West Virginia Agricultural Experiment Station.* The tree referred to contained thou-

* Catalogue of West Virginia Scolytidae, and Their Enemies, "Bulletin No. 31, West Virginia Agricultural Experiment Station."

sands of the insects in all stages of development from the immature larvae to the adult beetles. The insect's manner of destroying the pine is represented by plate.



SECTION OF BARK SHOWING THE TUNNELS OF THE PINE-BARK BEETLE. (*Tomicus cacographus*.)

The adult beetle bores through the bark of the green or partly decayed tree to the wood, then turns and runs its burrow between the bark and wood a distance of six or eight inches. At frequent intervals it deposits eggs in little notches made in the bark. When the eggs are hatched the small larva commences to feed on the sap and soft inner layer of bark until it has attained sufficient size and strength to start a burrow of its own, which it runs at right angles to the one made by the parent. The larva (fig. 1), when full grown, is about one-ninth of an inch in length, with a plump, soft white body and chestnut colored mandibles. In place of feet it has small round retractile protuberances on the under side of each of the first three segments. After attaining its full size it excavates a cell at the end of its burrow and changes into the pupa (fig. 2). In this stage it remains inactive until it develops into perfect beetle (fig. 3).

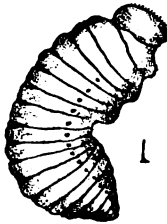


FIG. 1



FIG. 2

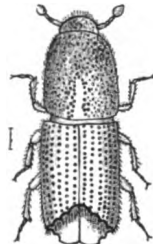


FIG. 3

PINE-BARK BEETLE. (*Tomicus cacographus*, Lec.)

Magnified, the small line at the side indicating the natural size.

The newly formed pupa is white, but afterwards changes to light yellow, and resembles the adult in form. The hind and middle legs are quite well developed, but the fore legs are only rudimentary. The antennae are prominent, and the wing cases are appressed to the side of the body. After developing into the adult or perfect beetle it makes its way to the surface by perforating the bark. The adult beetle is about one-eighth of an inch in length, and varies from a light brown to brownish black in color. Many of the lighter colored specimens are those that have most recently emerged from the pupa. The thorax is covered with elevated points and punctures, and the wing cases with twelve rows of coarse punctures. The ends of the wing cases are broadly excavated, and the edges of the excavations have five teeth-like projections on each side. This is the stage at which they again start their devastating work. Having the power of locomotion they fly from tree to tree, and the female seeks fresh places to deposit her eggs, so that the larvae may have nutritious food. Perhaps this power of locomotion will account for their appearance in our State. It might be said that they pass the winter in the pupa state, and perhaps many of the adults also survive

the winter. Mr. Hopkins found the adults as early as April 1st, and as late as November 7th; eggs, May 3d, 8th and 9th, and July 13th, 20th and 28th; larvae, May 18th, June 13th, 23d and 24th, July 28th, and November 7th. It is evident that they are more or less active in destroying our pine forests from May to November. After an examination of the partly dead tree, several trees that were killed in 1892 were examined. Traces of the work done by this beetle were to be seen under the bark, clear to the base of the tree. The wood was found perforated, or "pin holed," in all directions, and from these holes some of the beetles were taken. From the holes running across the grain were numerous tunnels between the growths, apparently the work of the larvae, and confined principally to the sap wood. This seems quite a departure from the normal habit of the insect, as the young larvae certainly could not find as nutritious food in that part of the tree. This perforation of the wood, however, may have been done by some other species of this family.

Under the bark of many of the dead trees was a black coating, which in some cases had penetrated and stained the wood. It was evidently a fungus growth that germinated under the favorable conditions presented by the dead tree. It was most prevalent where the bark was firmly in place and not undermined by the beetles. In view of the fact that the Pine-Bark Beetle, as a rule, only attacks trees that are large enough for lumber, fences and fuel, and as the pine forests of Southern Pennsylvania do not cover wide and extended areas, as in the Southern States, but are confined to comparatively small areas, situated on the sides of the hills and mountains, where they are readily observable, and as the present depredations of the beetle are confined to patches of limited extent, would it not be well to utilize all the dead standing timber and burn the refuse? Could not the owner of a tract of pine, when he first observes the attack of the insect, destroy them by burning the few trees infested and save his forest?

These suggestions can only be of service when taken in time, and would be entirely impracticable when the destruction became more general. There are two causes that will tend to increase the fatal work of this beetle, the lessening of our forest area and the destruction of our birds. The fewer the trees and plants that furnish food for certain insects, the more perceptible becomes their work. Again, the fewer the trees, the more valuable they become, and hence the harder we should work for their preservation. Our birds are becoming scarcer every year and it is evident that we do not realize their great value, or we would make more strenuous efforts to prevent their extermination. The birds that should be specially protected are those that are constantly about our trees, chief among these is the wood-pecker.

But there is another group of insects found on the trees that de-

mands our attention. These are known as the predaceous, or parasitic insects, and feed, to a greater or less extent, on the "Pine-Bark Beetle." Of this group Mr. Hopkins records over fifty species that prey upon the Scolytidae which are injurious to the pine and spruce. One of the most prominent of these is a beetle belonging to the family Cleridae, and known as the *Thanasimus dubius*, Fabr. (fig. 4).



FIG. 4

On the partly dead tree infested by the Bark Beetle we found six adults, and upwards of a dozen larvae of this species. It is closely allied, and similar in appearance to the *Clerus formicarius*, or "European Bark Beetle Destroyer." It is about three-eighths of an inch in length, head, thorax, base of the wing-cases, venter and legs red, eyes and the greater part of the wing-cases black, with two light irregular transverse bands, the light color due to whitish pubescence. The adult beetle was found in the cracks, and under the shaggy outer bark, while the larvae were found in the tunnels of the Bark Beetle. Both the adult and larvae are known to feed on the Bark Beetle. The West Virginia Agricultural Experiment Station have imported, from the government pine forests in Alsace, Germany, one thousand specimens of the *Clerus formicarius*, which were liberated in the pine forests near Morgantown, West Virginia, October 10, 1892.* That this beneficent insect is spreading seems evident, as it has already been recorded from the District of Columbia.

*Since the above was written, Mr. Hopkins, in an article entitled, "Destructive Scolytids and their Imported Enemy," published in the Twenty-Fourth Annual Report of the Entomological Society of Ontario, 1893, says, "eight importations, numbering 2,082 examples, have since been received from collections in Alsace and Saxony, Germany, and the living examples have been sent to the timber companies in five different counties, with special instructions for their proper location in colonies in the same manner as first mentioned. In all twenty-six colonies have been placed in different sections of our forests. The conditions surrounding each colony are most favorable for the Clerids to thrive and increase, and we may have every reason to believe that they will do so under their changed conditions, but as yet we have no means of ascertaining to what extent they have multiplied, and, of course, it is too early to expect results. There is one interesting fact, however, that I have observed this season regarding the destructive Pine-Bark Beetle, (*Dendroctonus frontalis*), and that is that its members have been very greatly reduced since last fall, consequently, at this time very little, if any, timber is dying."

Another beetle that somewhat resembles in size and color the Pine-Bark Beetle is *Hypophloeus parallelus*, Mclsh., a predaceous beetle, of the family Tenebrionidae. This species was quite common, both outside and underneath the bark of the tree examined. There were also specimens of *Tenebrivides collaris*, Sturm., *Pinacodera platicollis*, Say; *Hister parallelus*, Say, and an Ichneumon, Fly, or parasitic Hymenoptera of the family Braconidae. It is to be hoped that the many predaceous and parasitic species will tend to keep in check the wide spread destruction of our pine forests by the Bark Beetle. On these parasitic insects we must principally depend for the preservation of our forests. The introduction of the "European Bark Beetle Destroyer" is an experiment worthy of all the outlay, and its promotion deserves the highest praise. In closing this article, I wish to thank Messrs. George F. and Bartemas Smith and J. E. Downes, of Fulton county, for their kindness and assistance, and Messrs. Charles Liebeck and H. W. Wenzel for their aid in determining species.

CHARLES W. JOHNSON,
Wagner Free Institute of Science, Philadelphia, Pa.

CHAPTER X.

GERMAN FORESTRY METHODS.

The following sketch of German Forestry methods has been very kindly furnished to us by F. R. Meier, Esq., of 1222 North Fourth street, Philadelphia. In consequence of the limited space allotted to this report, we have found it necessary to abridge his very complete and practical account to a considerable extent, but we hope without in any way marring his work.

The general subjects are:

1. Of the time and manner of collecting seeds and of the mode of preserving them until used.
2. Time, place and manner of sowing seeds.
3. Establishment of nurseries.
4. Care of young seedlings until they reach the place of destination.
5. Choice between sowing and planting in general.
6. Methods of sowing or planting seeds in forests at once, where seedlings are to remain.
7. Influences surrounding the plantation.
8. Further care of the plantation.
9. Development of the forest; three methods of it: high forests, low forests, middle-sized forests.
10. Concluding remarks of high, low and middle-sized forests.

1. OF THE TIME AND MANNER OF COLLECTING SEEDS AND THE MODE OF PRESERVING THEM.

Seeds of the Oak, Maple, Beech and Linden are gathered in October; Birch seeds in September; Poplar and Elm in May and June; Ash and Alder in November. The cones of the varieties of Pine and Spruce are collected from October to March, and Larch cones are gathered in January and February. In gathering seeds, great care should be taken to ascertain their quality and ripeness. The seeds of only full grown trees should be taken, and they should not be gathered when the dew is on them, or immediately after rainy weather. If possible, take the seeds from felled trees.

Acorns are first dried, then piled on the floor, or in a covered and well ventilated space, in heaps not over a foot in height. To prevent the acorns from becoming heated, the heaps should be frequently and thoroughly stirred. If they are kept through the winter, they must be stored in dry and well ventilated places, otherwise they may become heated and sprout prematurely.

Maple seeds are obtained either by beating the branches of the trees, or breaking off the twigs. They should be kept in bags and stored in places not too dry. They are best preserved mixed with sand upon the ground.

Beech nuts are gathered by picking them up from the ground, or by beating the trees and allowing them to fall upon cloths held under the trees. They are freed from the outer coating by being thrown about and sifted. They may be preserved either in pits, by mixing them with common, fresh, dry sand, or on floors under sheds. Like all other seeds, they must be thoroughly dried. A few days prior to sowing, the Beech nuts should be thoroughly wet and placed in small heaps one or two feet high. This operation performed once or twice will bring out the white germs and render the nut in the most favorable condition for sowing.

Birch seeds are collected with the brown catkins or cones, which are dried and sifted to obtain the seeds. To keep them over winter they should be well dried and piled in heaps on the floor. As they become easily heated, frequent stirring is necessary.

Elm seed should be collected from the tree and sown at once, because it will soon lose its power of germination. As the seeds are often barren, it is well to carefully examine them by pressing them with the fingers before gathering to discover whether they are capable of germination or not.

Alder seeds are collected when the cones have taken on a brown color. They are sifted, spread on a board floor and often stirred. It is best to collect the seeds from the branches of the most fruitful trees. Sometimes the seeds are fished out of the water in the spring, but in this case they must be sown immediately.

The gathering of the cones of the Pine, Spruce and Larch should begin in November and be continued to March. When gathered, the cones should be heaped in dry, airy rooms, and often stirred. The separation of the seeds of the coniferae is effected in several different ways. One of the best is to fill bags with the cones, place them on shelves near the fire and frequently shake them. Slightly spray the cones with water from time to time, and remove those that have sufficiently opened to drop their seeds in the bags. The simplest way of effecting this separation is to spread a number of cones on a cloth in the sun on a warm day, turn them over frequently and spray them with water until the seeds fall from the cones, when the empty shells may be raked off the cloth, leaving the seeds. The seeds separated by the aid of the sun are the best and cheapest, but they cannot be used immediately in the early spring. They will, however, keep good for a long time.

Another method is to erect a place fronting the south, similar to the scaffolding for bees, of suitable width and height, with detachable racks of proper size, the bottom of which consists of willow

work, wire screen or sticks of wood. The meshes of this bottom should be of such a size that no cone can fall through, but sufficiently large to enable the seeds to pass through with ease. The racks should be so placed as to receive the full benefit of the sun's rays. A roof or shed should be placed over these scaffolds to protect the cones against the weather, and a box underneath to catch the falling seeds.

The separation of large quantities of seed by the larger establishments is performed by fire or steam, the description of which can be made sufficiently clear only by the aid of diagrams.

If one desires to carry on the separation of seed from cones on a small scale, he must place the bags containing the cones on a hanging shelf near the ceiling of his living apartment. The shelves commonly used for drying fruit may be used for this purpose. This process may be carried on from time to time while the heating of the room lasts, since the cones collected during the winter will not suffer from the ordinary temperature of the room.

The cleansing of the seeds consists especially in the removing of the wings. This may be done either by the wet or dry method. In the first case the seeds are slightly moistened and heaped up until they begin to swell, when the wings are forced away from the seeds without further manipulation. The seeds are again carefully dried.

In the second method, the wings are removed by putting the seeds in bags, or loosely wrapping them in strong cloth, and beating them on a layer of straw until the wings are removed. The further cleaning of the loose wings from the seeds is accomplished by means of grain cleaning rollers, or by tossing the seeds around. The removal of the wings should be done shortly before sowing. The seeds retain their power of germination the longest time in the cones or in the wings. They must be preserved in a cool place; frost does not injure them in a dry condition.

2. TIME, PLACE AND MANNER OF SOWING THE SEEDS.

The quantity of seed needed must be determined by a careful examination of the seed before the sowing begins. The reddish-white kernel of the acorn, the white and sweet-tasting kernel of the pignut and chestnut, the green and sappy seed-leaves of the maple, the wax-like, bluish white kernel of the ash tree, all indicate the germinating power of the seed. It is difficult to determine the germinating power of the seeds of the elm, the alder and the birch. The former are cut open for the purpose of investigating the kernel, and the latter must yield an oily moisture when squeezed by the fingers. The seeds of the cone-bearing trees must be subject to a closer trial. The grains should be laid between pieces of flannel, kept constantly moist and moderately warm until they begin to sprout.

The time of the natural falling of the seeds is the proper sowing time. Therefore, for deciduous trees autumn is the best; for the coniferae, the spring time is best. But even for deciduous trees it may become necessary to delay the autumn sowing until spring, (1) when there is danger that the seeds may be devoured by mice, birds or game; (2) as a precaution against frosts; (3) if the seeds cannot be procured soon enough, or the ground properly prepared.

Birch and Alder seeds are usually sown in winter time on the snow. Elm seeds are sown directly after their ripening in June; maple seeds in early spring, otherwise they may not germinate before the second year. The seeds of the ash and linden, which do not germinate until the second year, are either laid under the ground for one year and then sown in the spring, or, if already sown, the beds are covered with leaves, straw or branches to protect them from weeds. Generally, spring is considered the best time for sowing either in the open air or in a nursery. The sowing time of a country is early or later according to its climatic conditions. For mild climates, April; for rough lands, not before the beginning of June. Whether the earlier or later sowing is preferable depends wholly on the local weather relations.

3. ESTABLISHMENT OF NURSERIES.

We distinguish between permanent and temporary nurseries. If seedlings are to be raised which do not need protection by enclosure; if the first preparation of the ground costs little; if convenient places can be found anywhere, nurseries may be established in the immediate neighborhood of the places of culture, and one can do without the enclosure or the transport of the seedlings.

But where it is hard to find suitable places, and the first preparation of the ground is expensive; where danger to the seedlings and wild game, make an enclosure necessary; then one will raise the seedlings in a permanent nursery. In selecting such a spot one must take into consideration.

1. Situation. The spot selected must be protected against frost and heat, as much as possible. Avoid low lands, narrow valleys and situations exposed to the sun. It must have easy access for wagons, and be near the residence of a superintendent.

2. Ground. Of especial importance are the physical features of the soil, its looseness, its freshness and its depth. On that account sandy clay grounds will always be chosen before heavy ground. Moderately damp grounds will be preferred to such as are too dry or too moist, or too much exposed to frost or weeds, and deep soils will be preferred to shallow ones.

3. Territory. Land gently sloping toward the north or east is most favorable. It gets dry after the melting of the snow or after

rain fall sooner than a level surface. A level situation is not entirely objectionable, but steep hillsides must be avoided on account of the danger from heavy rains.

4. Previous use of land. Recently cleared spots in the midst of old forests are best, as they are fertile, free from weeds and offer protection on all sides. A soil laid open for a long time is usually dry and lacks richness. Ground previously cultivated is, in many cases, covered with weeds and requires clearing and cultivating, which increases the expense.

5. Surroundings. The neighborhood of fields should be avoided on account of the mice; that of cleared ground on account of weeds. An old growth of trees running east and west is desirable for protection against the southern sun; a belt of wood on the east affords protection against dry winds, frosts, etc. Protection by growth of trees on all sides, which should not be too dense, is best.

6. Shape. The shape should always be rectangular, either in the form of a square or a rectangle with a slight difference of sides.

7. Size. As a general rule an average of one-fortieth of an acre of nursery surface is required for each acre of culture surface.

8. Division of the nursery. In the middle of the nursery there should be a broad way, wide enough for wagons, and from which lead a number of by-ways for hand barrows. For the purpose of sowing, the quarters are divided into beds of such width, say five feet, that the sowing, weeding and clearing may be conveniently done from the side. Only for oaks and chestnuts are larger and more continuous sowing surfaces used.

9. Preparation of the soil of the nursery. A thorough loosening of the ground is most important, and may be done in two ways, in a new nursery. The first and rougher one is done in the fall after the soil is cleared from the weeds, the stones and roots being at the same time removed. The second and more thorough loosening of the soil may be made in the spring with the spade, the larger clods being broken and the remaining stones and roots being taken out. If needed, manuring may at the same time be done to the depth of about ten inches, followed by a complete leveling of the surface. The weeds cleared out of the nurseries, heaped together and in a decaying condition mixed with earth, may be used as a fertilizer. After the soil has been prepared, the sowing begins. This is done either by spreading the seeds over the whole surface or by distributing them in furrows, which is much better. The depth of the furrow is determined by the kind of seeds to be sown. For the coniferae (pines, spruces, etc.) the furrows need only a depth of half an inch, for the larger seeds, as the acorn, pignut, etc., one and one-half inches is sufficient. The distance between the furrows must be determined by the space required by the seedlings during the first year, and thereafter whether the plants shall remain in their beds

until ready for transplanting, or whether they shall be taken out after the first year. For slow-growing plants a furrow distance of four to six inches is sufficient; for larger ones, eight to twelve inches. The direction of the furrows should be in a line parallel to the shorter side of the beds. The sowing in the furrows is done by hand; the covering of the seed is done with a rake. The average quantity of seeds for seed beds is:

Of oak and chestnut,	1½ to 5 bushels to the acre.
Of beech,	4½ to 7 bushels to the acre.
Of ash and maple,	80 to 160 pounds to the acre.
Of elm,	60 to 120 pounds to the acre.
Of alder,	120 to 160 pounds to the acre.
Of birch,	120 to 200 pounds to the acre.
Of pine,	50 to 80 pounds to the acre.
Of spruce,	80 to 100 pounds to the acre.
Of larch,	160 to 200 pounds to the acre.

4. CARE OF YOUNG SEEDLINGS UNTIL THEY REACH THE PLACE OF DESTINATION.

The dangers to which the seeds, the germs and the young seedlings are usually exposed in the nurseries are visitations by animals, fungi, severe weather changes and weeds. Among the animals, birds are most destructive by devouring the seeds. This may be prevented by scaring them away or by covering the furrows with branches. Twigs of the coniferae are most effective. The nurseries are much injured by diseases caused by the fungi. The proper precaution against this is the proper selection of a nursery, because the remedies for checking the various diseases have not given satisfaction. The same may be said of the severe changes of weather. In order to protect the young crop against frost, if late frosts happen, cover them with grass, moss, chaff or twigs of coniferae. Artificial coverings are not advisable for large plantations. When permanent high temperature begins in summer, the coverings named above may be used. To protect the crop against weeds, either cover the soil in the furrows or pull up the weeds. To raise strong, well-rooted seedlings, those raised in the seed beds before being planted in the open air should be planted in a larger space. The pines are not to be transplanted if well developed in the seed bed, but are put in their place of permanent growth at once. After the first year, only the feeble material of pine that has been left is transplanted inside the nursery that their roots may better develop for future transplanting.

The transplanted seedlings remain according to the variety of wood and its development, two or three years in the nursery. The process of transplanting usually takes place in spring. In order to raise vigorous plants of oak or beech, the seedlings should be

transplanted several times in the nursery. The following distances seem to give the best satisfaction. For coniferae, the furrows should be six to eight inches apart, and the seedlings in the furrow should be from four to six inches; for deciduous trees, the furrows should have a distance of ten to twelve inches, and a distance of eight inches between the seedlings. In case of frequent transplanting, these distances increase to two or three feet. Besides, the transplanting seedlings must be assisted by loosening the soil and clearing out the weeds. The stronger leaved plants, as the oak, may be improved by cutting them to a pyramidal shape.

5. CHOICE BETWEEN SOWING AND PLANTING.

A. Sowing. Sowing is an artificial method of reproduction; a method of raising a forest by which the seeds of the trees are brought immediately to the place where the seedlings grown from them shall remain. It is the oldest and simplest method of cultivation, and has been used extensively. The advantages of planting, which are many, are undeniable in connection with cheap and sure methods of raising and transplanting the seedlings, and have in comparison with the former caused the latter to be preferred, and the former method (sowing) has been almost given up. Notwithstanding there are many cases where the raising of forests can be effected with good results and is decidedly cheaper by the method of sowing. It should then be preferred. Such cases are:

(1) The raising of woods on larger unoccupied spots with a well prepared, or cheaply preparable soil; former fields or places that have been used for agricultural purposes, or from which the stumps have been rooted out.

(2) The raising of wood varieties with a strong development of the main root.

(3) The raising of trees under protection of a surrounding growth of trees, as beeches under oaks, etc.

(4) The raising of trees on a very rooty and stony territory, as for instance a crop of spruce between roots and stones. The digging of holes for seedlings here would be very difficult.

(5) Want of laborers in general, of skilled ones for planting; large culture spaces after accidents, want of seedlings make sowing indispensable.

B. Planting. Formerly sowing was used, especially for deciduous trees, but on account of the gradual improvement of the raising of crops on the one hand, and in consideration of the methods of planting on the other, it has decidedly gained the preference among the methods of tree culture. It has reduced sowing partly, and partly displaced it entirely.

As decided advantages of planting may be considered:

(1) The protection derived from the stronger plants against dryness, frost, grass, game and cattle.

(2) The avoiding of too dense, slowly developing growths exposed to heavy snow falls.

(3) The wood production by the better and quicker development of the isolated plants.

(4) The ease of raising mixed forests.

(5) Being independent of the occurrence of seed years. Besides, one gains the purpose in many cases more completely and more cheaply by planting than by sowing. Indeed there are a number of cases where recourse must be had to planting. For instance, in raising delicate wood varieties in open air, on moist or even wet grounds, where grass and frost threaten the weak seedlings; and likewise on dry ground, on quick sand, or in newly planted breaks, in the rough highland and on plains exposed to strong snow falls.

6. METHOD OF SOWING OR PLANTING SEED IN FORESTS AT ONCE, WHERE SEEDLINGS ARE TO REMAIN.

A. Method of sowing. Though the general processes and conditions are the same for each variety of trees, still the special circumstances of the territory and other causes may induce departures, and these circumstances give rise to various methods of sowing.

First of all, there is spreading seeds over the whole surface, or sowing in furrows or other divisions.

(1) Sowing over the whole surface. (Unqualified sowing.) If seeds of trees are spread over the whole surface that is to be cultivated, in all its parts, without leaving empty spaces anywhere, this proceeding is called unqualified sowing. The most important part of the work is the preparation of the ground for a successful reception of the seed. It includes the removal of the weeds and the loosening of the earth to the required depth. The loosening of the surface must be done by a special operation, if it is very solid, or compact, or otherwise unfit to receive the seeds. Surfaces having land which has been unused for a long time are usually covered by shrubs, huckleberry bushes, ferns and dense grasses. These coverings are removed with strong iron rakes (Plate 25, Fig. 1), or with a peculiar hoe. But where the covering consists only of a short growth of weeds, grass, moss, etc., or where the ground is over-grown by a strong growth of huckleberry bushes, rubbish, etc., a temporary removal of these masses is, as a rule, not needed, and it takes place at the same time with the loosening of the ground, so that these coverings are either put aside or mingled with the soil. This is the more common method. On loose, poor, sandy soil it would be disadvantageous to completely remove the weeds, for they are here the most necessary material for the formation of humus. Even high bushes, brambles, etc., are not to be removed entirely.

The loosening of the soil for the preparation of the seed bed differs as regards its execution according to the depth to which one penetrates into the ground. A merely superficial loosening is effected by scratching upon the soil by means of strongly built iron rakes (Plate 25, Fig. 2); on level and clear surfaces by means of the ordinary field harrow with iron teeth, and where the ground is uneven and stony or rocky, by harrows adapted to the location.

The implements above mentioned for a superficial loosening of the ground may be recommended for a soft soil covered by grass or moss, on deserted meadows, pastures and generally on spots that one will, or need, not subject to a more thorough loosening.

The use of the plow is confined to level or moderately inclined surfaces. On slightly covered surfaces the common plows are sufficient. In the majority of cases, the forest ground, offering various obstacles to the ordinary plow, requires plows suited to the work, being of stronger construction than the usual agricultural implement.

Plows of various construction are in use. The steam plow recently introduced deserves a brief notice (Plate 25, Fig. 3). This plow, which penetrates from two to three feet, is to be used on hard tough ground. For moving it engines are used, which are put up on either side of the spot to be worked, and these draw the plow to and fro between them, fastened on wire ropes, the rope coiling itself up, now on the drum of the engine on one side, now on the other. When each furrow is made, the engines advance the width of one furrow. The steam plows accomplish eight times the amount of labor an ordinary horse plow does and the work is much more thorough and perfect. The complete plowing of an acre thus to the depth of two feet, costs about \$4 in Germany.

The more vegetable elements there are in the soil, and the more the loosening method brings up the underground earth, the more necessary it becomes for the prepared ground to remain lying over the fall and winter to allow the air, rain and frost to work on it before the seeds are sown. The more thorough the loosening, the sooner the sowing may take place. The sowing of the seed is done in the same manner as the sowing of grain. A uniform sowing is effected by sowing a second time crosswise. On sloping surfaces one sows only in a horizontal direction. The following seed quantities are sufficient in all ordinary cases: Acorns, 14 bushels to the acre; pignuts, 7 bushels; maple seed, 32 pounds; ash, 40 pounds; alder, 20; elm, 32; birch, 40; spruce, 12; pine, 6; larch, 16.

The covering of the seed depends on the size of the seed and how the ground has been prepared. If the preparation consisted of a superficial loosening of the soil, or only a rough treatment by means of the hoe, and the seeds are light, the covering is done by sweeping

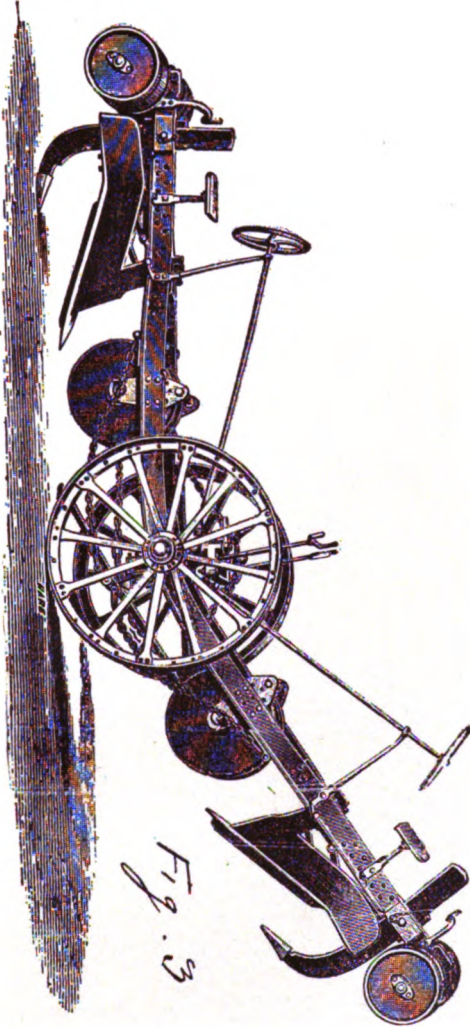


Fig. 1.

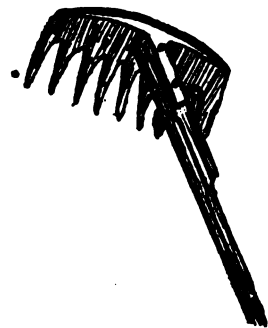


Fig. 2.

(Plate 25. See pages 137 and 138.)

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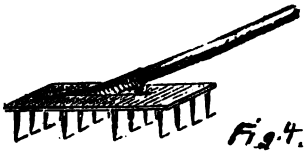


Fig. 4.



Fig. 5.

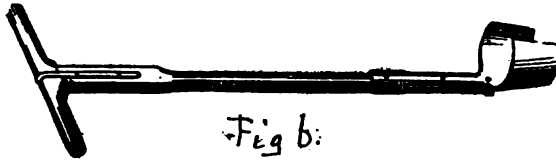


Fig. 6.

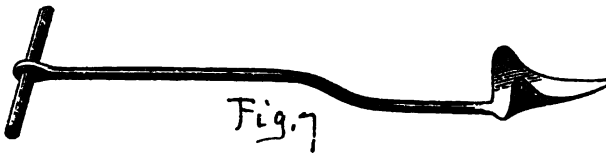


Fig. 7.

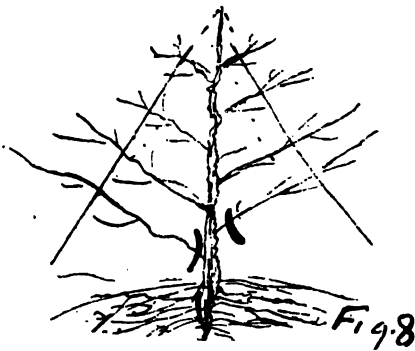


Fig. 8.

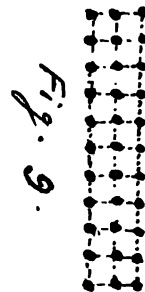


Fig. 9.



(Plate 26. See pages 140 and 141.)

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the ground by a brush. The seeds of the oak, chestnut, birch, etc., after a thorough plowing of the soil, should be covered in the same manner or by plowing lightly over them.

Unrestricted or unqualified sowing is one of the most expensive methods. It is, indeed, the most natural, as it causes the equal distribution of the seeds over the whole surface. For that reason it brings the quickest over-shadowing of the ground. If sowing is to be done, the unrestricted can be recommended only for strongly overgrown, uncultivated spots, for the raising of forests on little overgrown, deserted meadows, which have been prepared by the harrow, and for cases in which the ground only requires a superficial preparation, or none at all. Recourse is frequently had to unrestricted sowing on small lots of culture, on spots which are to be improved, or to secure seedling material.

(2) Sowing on selected spots. (Selective sowing.) If the sowing is confined to isolated spots, equally distributed over the entire surface, and separated from each other by slight distances, it is termed "selective sowing." These sowing places are distinguished according to their form and method as (a) "sowing in strips," and (b) "sowing in furrows."

(a) Sowing in strips. The places of sowing in this case are, more or less, uninterrupted strips of land, which alternate regularly with empty strips lying between them. The width of these strips in each case depends on the natural weediness of the soil, and also on the quickness of the growth of the tree to be sown. The more quickly the weeds grow, and the more slow the development of the trees to be raised, the wider must be the seed-strips in order to protect the seedlings against the weeds. The strips are usually one or two feet broad. On a soil covered with short grass, or none at all, narrow strips are sufficient. The distances of the strips or the width of the empty strips dependent on the growth of the trees, varies from four to six feet. By means of the hoe the upper part of the ground covered with weeds is removed to the width of the strips mentioned, and the ground thus laid open is loosened, if not loose enough. In case of a level surface, the rubbish is heaped up on south side and on the lower side of the seed strips, when the territory is sloping.

On level surfaces the direction of the strips should be from east to west and parallel with each other; on sloping surfaces they should be made in horizontal directions. Sowing of the strips thus made is almost invariably done by hand. On dry ground it is better for the seed to fall into strips on the side next to the rubbish, because the moisture is better retained there than on the opposite side. The larger seeds are laid in the strips at suitable distances. The following quantities of seed are generally allowed for sowing in strips. Acorns, 8 bushels per acre; pignuts, 4 bushels; maple seed, 20 pounds to the acre; ash, 30 pounds; alder, 16 pounds; elm, 25 pounds; birch,

16 pounds; spruce, 10 pounds; pine, 5 pounds, and larch, 12 pounds. The covering is done with small wooden rakes.

The sowing in strips admits of a much more extended application than the unqualified sowing. It may be used in almost any place where sowing is desirable, except on soil too much exposed to water, too rocky, or having many large roots. It entails the smallest expense for the preparation of the ground, and admits of more careful preparation of the seed bed, and offers to the younger seedlings more protection against weeds.

(b) Sowing in furrows. (Made by the plow.) This method is distinguished from the sowing in strips by the greater depth to which the ground is penetrated. The furrows are made with plows. The forest plow loosens the surface to the depth of one or one and a half feet, and turns it upside down. If only the common plow is used, the furrows produced are almost identical with the strips. In case strong weeds are in the ground, two or three furrows are laid over each other.

For the purpose of further loosening the soil, a second plow runs through the same furrow. The quantity of seed and its covering is the same as that stated under strip sowing.

(c) Spots and sowing in groups. In case of sowing in particular spots or in groups, a square or round area may be selected of no greater extent than is needed to receive a handful of seed, and to protect the young seedlings during their first years against a premature growth of weeds. The spots may have a diameter of eight to twelve inches, or from two to three feet. The diameter of the groups may average from four to six feet.

Since it is necessary according to this method to look for the irregularly scattered, but better places for seed spots, a regular arrangement and equal distances of the seed spots from each other cannot be expected. The preparation of the seed spots on strongly overgrown and weedy ground is made by the hoe.

For a superficial loosening of the soil and good covering of the seed on little overgrown but hard or stony soil, a rake is used (Plate 26, Fig. 4). On a soft, clean little overgrown soil an instrument as shown (Plate 26, Fig. 5). It is pushed vertically into the ground, and then turned several times around on its axis. The seeds are immediately sown in the ground thus loosened, and by repeated raking they are covered. On an average only three-fourths of the seeds necessary for sowing in strips are used in this case.

The sowing in selected spots and groups is better for level and slightly inclined places than on steeper ground, because the latter case the spots are too much exposed to water. It is not desirable on moist or wet ground, nor on territory too much overgrown by shrubs or weeds. On the other hand, sowing on selected spots may be recommended for strong or very rooty soil that is full of stumps and rocks, and on unequally prepared ground, and likewise for im-

provement of smaller surfaces between young seedlings and plantations.

(d) Sowing in holes. If the seed spots are no larger than is necessary for one or two of the larger seeds, or a very slight handful of the smaller seeds, this method is called sowing in holes. The distance of the seed holes from each other is determined by the circumstances mentioned, but since only a limited seed quantity is used, the seed holes must be nearer each other than in the other methods, say, from one to two feet.

B. METHODS OF PLANTING.

(1.) Time of planting. The same general rules apply to planting that have been mentioned for sowing. In general, spring is preferable to fall, especially for conifers, because the revival of vegetation follows immediately after the planting, and the young seedlings need not suffer from winter frosts, thawing and upheaval of the soil; nor from dryness, and the ground possesses under normal circumstances that degree of temperature and moisture which allows a quick rooting. Growth of grass and weeds retards the process of planting. Planting in the fall is usually limited to deciduous trees.

(2.) Taking out the seedlings. To be transplanted the seedlings must be taken out as little injured as possible. Seedlings are usually taken out of nurseries with the spade. To remove the seedlings one or two years old from the natural crops, a hollow spade is used (Plate 26, Figs. 6 and 7). The plants are clipped for the purpose of restoring the relation between evaporation from leaves and branches and absorption by the roots which was interrupted by taking them out of the earth. The clipping is best done in spring before the budding of the leaves. It should, however, be done only as far as necessary, and can only be done on deciduous plants. Longitudinal cutting should be avoided. Only lower branches are removed entirely; the upper ones are only shortened, and it is best to give the plant a pyramidal shape. Too long or injured roots are also taken off (Plate 26, Fig. 8).

C. Location of the plants. In this respect we have first to distinguish the regular and irregular location of plants. In a regular location plants are distributed not quite uniformly over the soil to be cultivated. The irregular location of plants may take place wherever geometrical regularity is of no account. It is especially used on small scattered places of culture, on spots covered with stumps or rocks or having more or less water and which do not admit of the uniform treatment. In the regular location of plants the distribution is made according to certain geometrical figures. Therefore we distinguish plantations in squares (Plate 26, Fig. 9), in triangles (Plate 27, Fig. 10), in pentagons (Plate 27, Fig. 11), and in rows (Plate 27, Fig. 12).

For larger places of culture the regular method is better, because

it reduces the work of planting. Planting in rows is most in use. It is simple and easily accomplished. In general one plants so densely that the soil may be covered by increase in size of the young trees in about five years. The plan of location of plants is determined by various circumstances; first, by ground and situation, for on all such places as offer obstacles to the growth and to the prosperity of the plantation, the soil must be more densely planted, especially on spots where a speedy covering is desired.

Evidently the variety of trees is also important in this respect. Trees requiring shadow must be brought closer together than other trees. In order to produce an early, slender growth of timber, close planting must be done. In modern times plantations of broad or deciduous leaved trees, especially oaks, are made quite roomy, according to the quality of the ground, say, ten or twelve feet to the square. At the same time spruces two or three years old are planted in pairs between the oaks at about four feet apart. This is the so-called "under plantations." This method has the advantage, first, of cheapness, and second, of making a quick covering of the ground; thirdly, of early usefulness. Finally, the expenses are greatly influenced by the method of location of the plants, for by diminishing the distances about one and a half feet the expenses of culture become more than double. In general the results of wide planting are not favorable. Wide plantations are to be recommended only for quick growing trees which require much light, especially ash trees, maples, elms, lindens, and larches. For the other trees close planting should be done.

According to the following determining circumstances the absolute measure of distances for the plant must be fixed. On poor dry ground the planting must be closer, because the development proceeds more slowly, and the soil must soon be covered. On an average the following are the distances for planting. The work of planting may be done in different ways, as various conditions require various methods. It is of prime importance whether it is the common method of planting in holes, or in heaps of earth. Of these two methods there are various sub-divisions.

TABLE OF DISTANCES FOR PLANTING.

Variety of Trees.	Age in Years.	Distance in Feet.	Remarks.
Oak,	4	6	
Do.	7	10	
Beech,	4	4	
Do.	7	6	
Elm,	3	5	
Do.	6	8	
Maple, ash, linden and birch,	3	5	
Do. do.	6	8	
Spruce,	2 to 6	4	
Pine,	1 to 3	4	
Larch,	2 to 6	4 to 6	

PLANTING IN BALLS.

The seedlings are furnished by the nurseries, or are a natural growth.

Preparation of the ground. For planting seedlings in balls, the holes are cut into the ground with the same instruments (Figs. 6 and 7), with which the balls have been cut out of the earth in order that as complete a junction may be effected as possible for the sides of the balls with the sides of the holes.

Insertion of the plant. The ball must be sunk completely in the hole, with its upper surface level with the ground, on dry loose ground. It may even, for the purpose of gathering moisture, be sunk a little deeper. The balls should, of course, not stand loosely in the holes; that is, without joining the sides of the hole, the close attachment being of more importance. The same junction is accomplished by settling the earth around the young plant with the foot, and is more easily effected in loose ground than in hard.

Value and use of planting seedlings in balls. The success of ball planting depends on whether the whole root system is inclosed in the ball or not. It is easy to understand that, on account of this, seedlings one or two years old must yield better results than older seedlings. The seedlings in balls suffer in a hard soil, especially after the commencement of summer heat, because the balls contract themselves and the holes get wider and the moisture evaporates. But in cases where all favorable conditions exist, the planting in balls is the surest method of planting, for the development of the root is not interfered with. It is especially to be recommended on sandy ground, whether it is wet, moist or dry; even on quicksand, on spots which are exposed to frost, on very much overgrown places, and on chilly situations, where other methods of planting fail to give satisfaction. Besides, the balls are a protection against insects. The planting in balls is not to be recommended on strong and thin soil. Ball planting entails but moderate expense, especially when its success is considerable.

PLANTING WITH BARE ROOTS.

(1.) **Planting by hand.** The seedlings are usually furnished by the nurseries.

(2.) **Preparation of the ground.** After removing the surface the hole for the seedling is dug with a strong narrow hoe (pick axe). The size of the root system of the seedlings determines the width and depth of the hole. The harder the soil the more the hole is extended to increase area of loose soil. The holes are made directly before the planting, especially on grounds inclined to dryness, and also on wet grounds to prevent soaking in of water which fills the holes. On rough, wild ground the holes for the spring planting should be made the preceding summer and fall, so that they may have all the benefits of the winter tempering.

Inserting of the plants. (Plate 27, Fig. 13.) The seedlings are held in the ground singly or in pairs in such a manner that the part where the roots commence to grow from the stem is in a line with the surface of the soil, so that all roots are comfortably lodged in the hole. The seedlings of conifers are inserted somewhat lower than they were in the nursery. Great care should be taken after planting the seedlings that the earth is well packed in around the roots. The preservation of moisture is secured by surrounding the root of the plants with pieces of sod turned upside down, and stones. It may be recommended not to fill the hole entirely on dry ground, but to leave a space around the foot of the plant to serve as a kind of reservoir for rain water. The best instruments to be used are small short hoes of various shapes.

Relative value of method. Planting by hand is the most simple and natural, and applicable to all kinds of plants, especially for vigorous ones. It may be used on almost any ground, but not so successfully on wet and shallow soil, for which other methods are better. On strong and hard ground, it is almost the only method. It is easy to understand that this plan is not only for isolated holes, but for strip and furrow planting.

Planting by splitting the earth open and squeezing in the plants. The characteristics of this method are; the hole for the seedling is split open by a cutting iron (Plate 27, Fig. 14). No earth is thereby taken out. The same iron is then used to squeeze the earth together again around the seedling by pressure from the side. This method of planting is only suitable for small seedlings, those less than three years old.

Preparation of the ground. No preparation is needed on a soil that has been cultivated, or overgrown, or covered with leaves and moss. But in most cases the ground must be prepared for the reception of the seedlings by removing the covering, or in a more or less thorough loosening of the soil. On soils that are strongly overgrown, a plow is often used to make the furrows.

Planting. The cutting of the plant holes and the insertion of the seedlings are one continuous act. Instruments (Plates 27 and 28, Figs. 15, 16, 17 and 18), of different shapes are used for the purpose. Usually those with long handles are preferred. One laborer cuts the hole, and while the seedling is held in the same by another he squeezes the separated earth together again by a second use of the iron close by the side of the hole.

Relative value of this method. The method of planting by squeezing has in recent times become popular because of its usefulness and cheapness. For planting one year old saplings, it is not only the cheapest method, but less expensive than sowing. It is not suitable, however, for hard soil, or sandy places.



Fig. 10.



Fig. 11

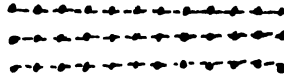


Fig. 12

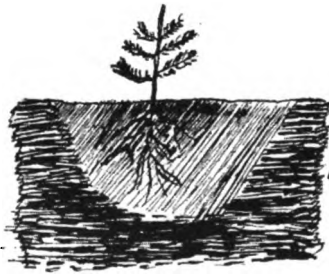


Fig. 13.

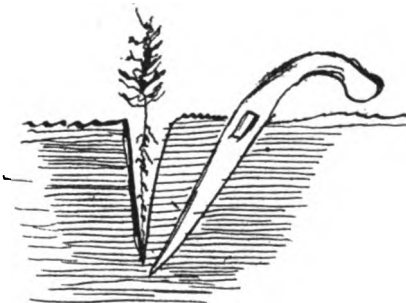


Fig. 14.

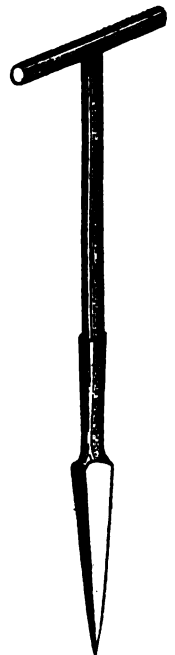


Fig. 15.

(Plate 27. See pages 141 and 144.)
Forestry Implements.



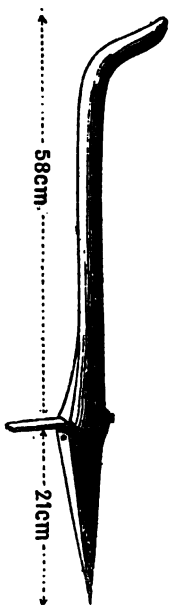


Fig. 16.

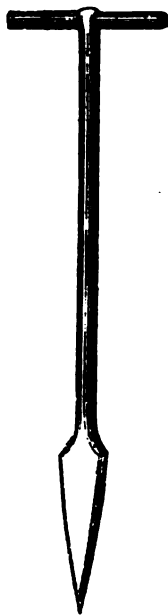


Fig. 17.

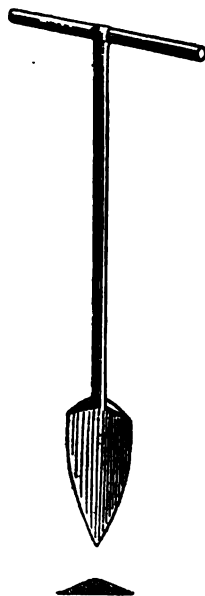


Fig. 18.



Fig. 19.

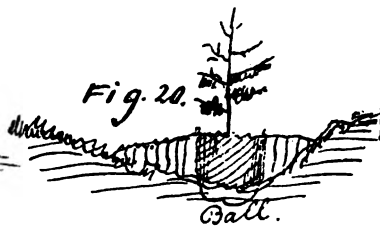


Fig. 20.

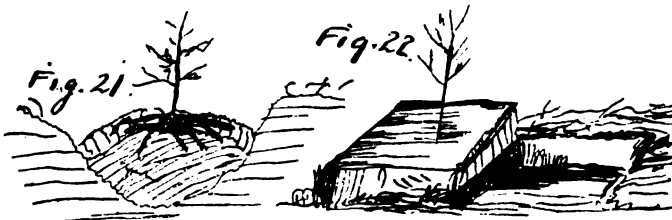


Fig. 21.

Fig. 22.



(Plate 28. See pages 144 and 145.)

Forestry Implements.

Plate 28, Fig. 19. The sod is removed on the selected spot, the ground laid open, the earth taken out and at once formed into a heap, in this the seedling is immediately planted. After the insertion of the plant, the turf is used to cover the earth-heap as a protection against dryness.

Plate 28, Fig. 20. In this case the plant with balls is placed on the spot and surrounded with earth. There too, the covering is done by means of sod. This method has given much satisfaction on poor and chilly soil.

Plate 28, Fig. 21. For this method the surface is removed to a depth of one or one and a half feet, the ground loosened and heaped up in the middle so that around it a furrow remains. On that heap the seedling is placed, the roots are well surrounded with earth and the remaining earth is placed around. The great success of this method is to be explained by the imbedding of the roots in the loosened ground, keeping the heap wet by means of the rain-water collected at its foot, and the high-planting. It is used in planting spruce on chilly high lands.

Plate 28, Fig. 22. Sodds of one or one and a half feet square are cut on the spot of culture and turned upside down. This should be done in fall, that the turf may decay. In spring the seedling is placed on those turfs.

Finally, we should mention the planting on border-beds. On the place of culture parallel furrows are made, the earth taken from them and thrown on the strips lying between them, and then the planting takes place on the ridges so made.

Value and use of the high-planting in general. As already remarked, wet are generally chilly spots; against that danger the latter method offers protection. Those spots are especially rough and frosty mountain situations with grounds inclining to marshiness, but otherwise favorable, on which these methods have given satisfaction, providing vigorous plants of middle size are used. Another reason for using this method may be an unusually strong growth of grass and correspondingly dense sod. The planting on heaps is an expensive experiment on grounds not suffering from frost, moisture or overgrowth.

7. INFLUENCES SURROUNDING THE PLANTATION.

The success of the method depends not only on the special character of the ground, though this is very important, but also as experiment teaches, on the advantages of protection which it enjoys against external dangers, and on the position and area of the plantation.

Suppose the place of culture is entirely bare without any protection, and the ground is uncovered by an agricultural operation.

It is of great importance whether the place of culture is isolated from the forest, or lying in the midst of it. The isolated heaths, plains, swamps, bare ridges, uncovered mountain spots, etc., offer great difficulties to planting, especially if these have been without shrubs or trees for years and are strongly overgrown with weeds. Such a ground suffers either from dryness or moisture. Forest humus is wanting. If the latter is missing the important mineral fertilizers are swept away from grounds poor in clay; the uncovered ground is hardened by rain; the young plants therefore are exposed to all weather extremes. All these disadvantages menace the growth of the plantation, and in many cases it must be sufficient to take the first planting only as a preparation for the final culture. Those disadvantages are slighter on places which are under the protection of forests. The larger the plantation the more it depends for moisture on the climate of the year, and so much the more becomes the danger from insects. If such extensive uncovered spots have a loose soil, they frequently become permanent centres of the worst enemies among insects and fungi. Therefore the unprotected culture places are limited to a moderate area, and the places at the same time to be planted are divided into small patches which are as widely separated as possible. If a plantation does not enjoy protection by the older trees still remaining on the place of culture, it must get protection from trees planted on the side.

A protecting growth of trees standing against wind and sun toward the south and west is a very desirable protection. The protection from the side considerably reduces the damage done by insects and frosts, and has given much satisfaction against too strong snow fall and ice.

Places having lain idle for a long time and being constantly exposed to cold winds, highlands suffering from unfavorable climate and inaccessible spots, can frequently not be successfully planted at one attempt. In this case, this previous raising of a strong variety of trees is very helpful in the shape of protective thickets, which offer the succeeding tree growth the desired protection from the side.

8. FURTHER CARE OF THE PLANTATION.

In the long interval between the planting of a forest and its final use, many trees are removed and only a small fraction of the plants present in the first years form the final main forest. All others succumb to the overgrowth of these predominant trees. They are suppressed or die out. The cutting out of these suppressed trees, before their dying, is done for two reasons; to favor the growth of the remaining trees and to utilize the lumber thus obtained, which is one of the main uses of the forest.

Besides the valuable material derived from the suppressed trees,

the protection enjoyed by the remaining trees on account of their quicker growth and greater power of resistance to snow, is another important point. Moreover, with the suppressed and sickly trees, the haunts of the detrimental insects are removed. The thinning out is commenced early, as a rule, when the trees drop their lower branches spontaneously, which is generally in the twentieth year of pines, from the twenty-fifth to the thirtieth year for spruces, and for deciduous trees from the thirtieth to the fortieth year.

The following rules must be observed in removing the suppressed trees:

1. Be careful in selecting the tree to be cut out.
2. Only few trees should be taken out of forests on hot, dry and poor ground.
3. If timber and lumber are objects for which the forest was planted, it should be kept closed; that is, dense as possible, removing only those trees that are weak or crowd better ones.
4. Never take out so many trees that the junction of the branches is interrupted; that is, always allow branches of adjacent trees to touch.
5. All varieties not belonging to the main forest, as well as all deformed trees, should be removed.
6. The borders of the forest towards the south and west must be kept close.
7. Spruce, ash and alder requires the closest growth; beech, elm, maple and oak a very close one; pine and larch require an open one, and birch the most open of all.
8. On an average, every ten years, an examination of the forest should take place for removing the weak and sickly trees.

9. DEVELOPMENT OF THE FOREST.

The formation of the forest results either from sowing, planting artificially, or naturally by falling seeds, or sprouting from stumps after cutting. Just as different as the formation, is the development of the forest. The latter is allowed to form short brush-wood only, or powerful tree trunks, or forests in which both are united. The application of one or the other mode is called raising.

The methods especially to be designated, are:

1. Raising of High Forest. In it the trees are raised to their natural height, and to an age in which they cannot only reproduce themselves by dropping seeds, but give also the best and most timber.
2. Raising of Brush-Wood. (Low forest.) In this case the trunks are allowed only to reach a small size; they mature no seeds, but reproduce themselves by sprouting from the trunks.
3. Raising of Middle Sized Forests. As the name implies, the

middle forest ranges between high and low forest. It is a combination of both, in such a manner that on the same territory by the side of brush-wood, which is used for fuel and produced by sprouting from the stem, the timber is raised, which reaches mature age and is capable of producing seeds. Profitable production of timber is the object of this method. It is more lucrative than mere low forest raising.

The main difference of these three methods is the time required by each. The usual time before utilization of high forests is from 80 to 120 years; of low forests from 10 to 20 years. In the middle sized forests for brush-wood the time is from 10 to 20 years, which is the same as that for the low forest. The time of cutting is mostly dependent on the market after the maturity of the crop. That time is selected which promises to yield the largest and quickest financial returns.

1. High Forest. The high forest method is most common. It is this which mostly, if not exclusively, furnishes the timber the trades need, and on whose delivery, in the first instance, the profits of a forest rest. It is that method of raising which on the one hand requires the least productive soil, for the amount of mineral elements taken out at each cutting is considerably smaller than that removed from the ground at the cuttings recurring in the same period, four to six times, in the low or middle-sized forest.

Natural Reproduction by the Falling of Seeds. The reproduction of trees naturally by falling seeds occurs in almost any kind of forest, but especially in great deciduous forests and also in some forests of conifers. In order thus to secure a good natural reproduction the following requisites must be observed.

1. Raising of seed trees.
2. Copious falling of good seeds.
3. Preparation of a seed bed.
4. Protection in germination and growth of seeds.
5. Removal of all trees obnoxious to the young growth. This is done by timely removal of all superfluous trees. We have to distinguish three main divisions according to the progressive development of the young growth.

- (1.) Preparatory cutting.
- (2.) Cutting to make room for the seed.
- (3.) Complete cutting.

1. Preparatory Cutting. It is done for favoring seed-production and to prepare the ground bed. The seed development is favored by loosening the dense interlacing of the branches, that light and heat may have freer access.

Great care is necessary to taking out the trees not to expose the ground too much, thereby causing poor ground, and deterioration as well as local overgrowth by seeds on good soil.

Favoring the seed trees, that is, trees of good strong growth and many branches, as many trees are taken away as will allow sufficient light to fall on the ground through the loosely connected branches, and then to cause a quicker and deeper decay of the vegetable mould. On good soil, where the shade is dense, more trees are removed than on slopes and on limestone soil. One commences the preparatory cutting about five or ten years before the intended re-planting—the earliest on sandy ground.

Cutting to Make room for the Seeds. The purpose is to allow a proper distribution of seeds, and to facilitate their germination. As soon as the seed trees are ripe, the good seed trees to be retained are marked while the feeble ones are removed. Only so many trees should be removed as to allow about two-thirds or three-fourths of the number to remain, and the distance of the ends of the branches overhead should be from four to nine feet on an average. Beech and spruce require a denser shade than the other trees. On the south and west sides more trees are left than on the north and east. The removal of the timber must be finished before the germination of the seeds. (About the middle of April.) An impoverished and weedy soil requires loosening for the reception of the seeds. This may be done on different spots or in strips, besides the previous presence of pigs may be recommended because they loosen the ground and devour insects. Sowing and planting to assist the natural dissemination may take place when too few seeds fall, or where expensive preparation of the ground would otherwise be necessary.

Complete Cutting. Complete cutting is rarely all done at one time, but by degrees. Those trees that need much shade require a very careful and gradual reduction in this number. The more light a variety requires, as indicated by their leaves, the sooner must the main trees be removed. For the beech the complete cutting may extend over a period of ten to twenty years; of pines after a fresh crop of seed is sown and started, the principal trees may be cut within two to four years; the other variety of trees come between the two periods mentioned. The proper time for removing the adult tree is indicated by the young growth. If the young trees are oppressed by their weak growth (with spots on the leaves, thin buds, etc.), too few old trees have been removed.

When weeds become rampant or damage is done by frost or heat, too many trees have been cut. Small breaks are planted according to their situation with beech, maple, ash on lime or basalt ground; with oak on good clay ground; with spruce on the more clayey surface of mountain ridges and borders of mountains with overgrown ground, and with enfeebled old trees which are naturally excluded from reproduction, and are not cut until the young growth in the better parts is developed and replaced by pines and spruces.

2. Low Forests (brush-wood). The characteristic of this method is

that the trees are several times utilized in short periods. The reproductive power of the deciduous trees is in about the following order: alder, oak, maple, ash, linden, poplar, willow, birch, beech. By an early cutting of the grown trees the power and disposition to sprout is increased.

The quantity and quality of the wood produced is determined by the free access of sunlight and moisture. The reproductive power decreases as the age increases. In cutting, care must be taken that the single trunks be cut as low as possible. Since every tree cut sends out many new growths, room for the development of the sprouts is desirable. The averages distances of the trees apart is from three to six feet. The low forest trees prevent dangers from frosts, if always cut from western side to eastern side of the plantation. [This rule would probably not hold good here. J. T. R.] On slopes, cutting is done from the foot to the peak. The age of cutting birch trees (sprouts) is from twenty to thirty years; for alder, fifteen to thirty; maple and ash, twenty to thirty; beech, twenty-five to thirty-five; and oak, fifteen to twenty-five.

3. Middle Sized Forest. Middle forest may best be raised, as remarked, from low wood: at each cutting of the underwood an appropriate number of good trees being left until the desired main-wood is reached. The direction of the cutting process is from west to east as in low woods. For trees to remain, only healthy, well formed, good growths are selected. The greater or less distribution of light or shade for large wood in middle sized forests is regulated by,

1. On fresh and deep soil, and on slopes more large trees must be left than on poorer, more shady ground, or on plains.

2. The Cutting of the Underwood. The more frequently this is cut, the more well-grown wood must remain standing.

3. The Question of Demand and Supply. As a rule how many larger trees shall be left on the place cleared of underwood? The following numbers may be considered as approximate. When an underwood twenty years old is cut there are left:

- 3 trees of 120 years of age per acre.

- 4 trees of 100 years of age per acre.

- 6 trees of 80 years of age per acre.

- 8 trees of 60 years of age per acre.

- 10 trees of 40 years of age per acre.

- 15 trees of 20 years of age per acre.

The best large trees for middle-sized forests are oak, ash, elm, larch, spruce and birch. The most suitable trees for underwood are the following, in the order given: beech, hazel, elm, linden and all tree varieties of little value.

10. CONCLUDING REMARKS ON HIGH, LOW AND MIDDLE-SIZED FORESTS.

If we compare the advantages and disadvantages of the three methods, we find high forests require large surfaces, they preserve and improve the ground, furnish the largest and most profitable returns, offer the most direct collateral profits, but they are liable to various serious accidents.

Low forests require the least area, return a considerable revenue, especially where oaks and willows are cultivated for tanning purposes. On the contrary, they yield a small return in wood.

The middle-sized forests may be raised on surfaces of any size, but require a rich soil, they preserve the fertility of the ground, if properly cared for, and yield results little less than those of the high forest. It makes raising of the strongest trees with wood of best quality possible, and is but little liable to serious accidents, but does not offer any collateral products. It must be managed by experts, if it is to reach the largest success.

It is well here to indicate the classes of land owners to which each method of forest culture is best adapted. Thus, the high forest method requires a long stretch of years and a large area, in order that each year extensive cutting may be possible. It is then, of course, better suited to the operation of the State, of corporations and wealthy individuals, who can afford to wait for slowly but surely accruing profits.

The low forest, whose chief object is to product oak bark, or willow or wood for fuel, is more suitable to smaller private land owners, who can only use a moderate capital for forest purposes.

The middle-sized forest is best suited for private forest owners, whose land surface is too small to use advantageously as high forest; likewise for remote parts of forest; it yields all the wood product in short periods, and for that reason it yields large and oft repeated profits.

We see that each method has its advantages and disadvantages, and that each one should be used according to circumstances. The difficulty consists in selecting the proper method of the three for a certain territory, after taking into account all the determining circumstances.

CHAPTER XI.

SUGGESTIVE NOTES ON PROPAGATION.

With the exception of a few energetic nurserymen, who have made a specialty of growing forest-tree seedlings, our people are sadly ignorant of the best methods of reproducing the arborescent flora of this country in sufficient numbers to be remunerative. The necessity of a few general principles governing the operation, suited to our peculiar and changeable climate, as well as to our various and often uncongenial soils, must be apparent to every one.

The result of foreign experiments and practice are of little value to us. We must learn from our own experience just what we need in the way of artificial assistance in germinating seeds, as well as protecting the embryo plant during its earlier stages of growth. In the following brief notes, the writer disclaims all credit of originality, desiring only to assist the younger generation of tree-growers with a record of the methods he has found most successful in his own work, and on his own soils. The systems recommended will be elementary, and be as devoid of technicality as the subject will permit, consistent with a plain statement of facts governing each species.

The following trees, although the list is necessarily imperfect, are all of sufficient economic importance to recommend for forest-culture in Pennsylvania:

CUCUMBER-TREE.

(*Magnolia acuminata*). (Sargent, *Silva N. A.*, Vol. I, p. 7, t. 4, 5).

A beautiful native tree for ornamental planting, forming in good soils, specimens seventy-five feet high. The timber is of sufficient importance to encourage its cultivation, which may readily be attained by the most unskilled in tree-culture. The seeds are contained in large fleshy cone-like fruits, and at maturity hang by threads from the carpels. The hard bony shell is enveloped in a red fleshy covering, that must be removed by washing to facilitate germination. After they are quite dry, the seeds should be mixed with equal parts of sand and placed in a cool cellar until the following

spring. All tree-seeds must be committed to the soil as soon as feasible in March or April, depending on the condition of the ground. Fresh manure should never be used, but mineral fertilizers in limited quantity; wood-ashes or bone-dust are excellent.

After a thorough plowing, the surface may be laid out in beds five or six feet wide, and receive a careful raking. The seeds are best sown thinly in shallow drills across the beds, thus allowing the soil to be constantly stirred by means of a narrow hoe. Weeds are the greatest enemy we have to contend with, and must always be kept in subjection.

After remaining in the beds for two years, the seedlings should be of sufficient size to transplant to their permanent home if needed for forest-culture, or to nursery-rows if for ornamental purpose. In preparing the soil intended for a permanent plantation of forest trees, deep plowing is of undoubted importance, and autumn is preferable to spring for the operation. Setting the seedlings with a proper "dibble" is the most economical method, as a man and boy can plant more in a day than three men can successfully handle in the same time by any other system. The proper distance apart to place the seedlings, is still a disputed point, even among our best practical foresters, but that the soil should be thoroughly cultivated for a few years after planting, is an acknowledged fact. As the seedlings are very cheap, it is better to set a liberal number with the intention of removing the surplus later on, than to practice false economy by using the exact amount necessary to form a plantation when the trees are grown. If the young seedlings are "dibbled" in rows that have been marked out four or five feet apart, and set about eighteen or twenty-four inches distant in the row, they will make a rapid growth from the start, especially if well cultivated. In two or three years from planting alternate trees may be removed; and in time, alternate rows may be dug and disposed of for various purposes. Little pruning will be necessary, except to remove a branch that prevents the straight upward growth of the tree. Whenever an individual inclines to be crooked, or to form a compact rounded head, it is best to cut it off near the ground, and permit a strong sucker to constitute an entirely new plant.

These general principles will be found applicable to most forest trees, with slight modifications. Consequently, in subsequent descriptions, whenever special advice is omitted, it is understood that the foregoing rules may be adhered to.

TULIP-TREE.

(*Liriodendron Tulipifera*). (Sargent, Silva N. A., Vol. I, p. 19, t. 13, 14).

One of the finest trees, commonly although erroneously, called "yellow poplar." Its majestic proportions reach in deep alluvial soils, upward of one hundred feet in height, with mostly a perfectly straight trunk, entitling it to a front rank in the list of available trees for forest culture. It is an exceedingly rapid grower in suitable soils, and soon outstrips most other species. This and the *Magnolia* are the only genera constituting the Natural Order *Magnoliaceae* to be found in the Northern States, and although the root-formation in the two genera is very similar, the seeds and cones are not at all alike. The elongated cone of the tulip-tree is dry at maturity and falls apart, and the seeds which are not difficult to germinate in moderately moist earth, soon produce young plants in early spring. The seeds may be gathered as soon as ripe and preserved in a cool, dry room until spring, when they should be sown thinly in shallow drills.

They are not long in showing above ground, when all that is necessary in the way of cultivation is to keep down the weeds and occasionally stir the soil. All trees with succulent roots, such as the *Magnolia* family, are impatient of removal in autumn. But during spring, after the soil has become moderately dry, the risk is lessened. Young seedlings especially should not be permitted to dry, or their chances of living are very small. To preserve the roots moist and healthy, it is advisable to dip them in what nurserymen term a "puddle."

They should be placed at once in a bucket, and taken out one at a time to set in permanent rows. This puddle is a mixture of clay and water of the consistency of thick cream, and must be stirred until perfectly smooth and destitute of lumps.

BASSWOOD, AMERICAN LINDEN.

(*Tilia Americana*). (Sargent, Silva N. A., Vol. I, p. 52, t. 24, 25).

Among native trees for ornamental purpose, this is of special interest wherever a rapid growing umbrageous tree is needed. It is particularly valuable for avenue and street planting, being remarkably healthy and free from injurious insects. As a forest tree for

timber purposes, it is one of the most valuable, the wood being white, soft and readily worked; hence one of the common names by which it is known—"white wood." The only objection that can be made respecting its value for shade, is the predisposition of its foliage to drop in advance of most other species.

This, however, is not very serious, and is counterbalanced by the large size of the leaves, especially on young and vigorous specimens, that cast a dense shade during the hot summer months. To the apiarist, the blossoms of the linden are of great value as honey-producers for their bees. The bright, cream-colored flowers possess an agreeable fragrance, that is an additional recommendation for planting near the dwelling. The fruit is nut-like with a leathery or woody coat, and may either be preserved dry during winter, or sowed in beds as soon as ripe in autumn. The care of these seedlings during the time they remain in beds, need not differ from that recommended for the foregoing species, but it is advisable to give all seedlings, especially during the first winter, a slight protection of leaves or evergreens. The frequent freezing and thawing in our changeable climate has a tendency to "heave" out all young woody plants.

WHITE BASSWOOD.

(*Tilia heterophylla*). (Sargent, *Silva N. A.*, Vol. I, p. 57, t. 27).

A distinct and attractive species for ornamental planting, with larger leaves than the above. The under surface being silvery-white imparts an additional interest to the foliage. It is the "*T. alba*" of Michaux, and is so listed in many catalogues, especially abroad. Its economic importance is probably about equal to the common basswood, although more uncommon. Perhaps it would be well to state that this family is readily increased by the system of inoculation, or as it is technically termed, budding. The young shoots from the buds will frequently grow from six to eight feet in height the first season, and usually be as straight as an arrow.

SUGAR MAPLE.

(*Acer saccharinum*). (Sargent, Silva N. A., *Acer barbatum*, Vol. I. p. 97, t. 90, 91, 92).

A well known native of the Northern states, and one of the handsomest species in cultivation. It forms a large size tree, with a perfectly upright and straight trunk and round symmetrical head, and is unsurpassed for use on the lawn, or for avenue planting. Unfortunately, of late in some sections of Eastern Pennsylvania a devastating blight has attacked this species and the loss of many beautiful specimens has been the result. During the autumnal months, this tree is especially noticeable on account of its rich golden color, although not so brilliant as the tints of the red or swamp maple. It makes a fairly rapid growth in suitable soils, but is inferior in this respect to the white or silver maple. To the forester it is of considerable importance, as the straight, round body and hard, compact wood entitle it to precedence for timber. Its propagation is by no means difficult, if due precaution is taken to prevent the seeds from becoming dry before planting.

The fruit is what is termed "keys" or "samaras," that is a wing attached to the back of each seed, which, in the case of maples, grow in pairs. The seeds should be sown as soon as they are fully ripe in carefully prepared beds of fine soil, and covered with a thin coating of leaves. The young plants will start quite early the ensuing spring, but will not be very vigorous the first season. It is necessary to prevent them from being stunted, or, indeed, from being entirely smothered by a growth of rank weeds, and this must in consequence never be neglected. An occasional hoeing is of decided advantage in accelerating growth in the young seedlings, which, however, should remain in the beds for two seasons before setting out in rows. In the vicinity of native woods composed largely of sugar maples, an abundance of young seedlings may very readily and cheaply be procured. These embryo trees are easily pulled from the light loose earth, and may then be set thickly in beds for one year, with a protection of evergreen boughs for the first summer. This maple inclines to branch freely if set thinly in the rows, consequently, if needed for forest growth, the young plants must be "dibbled" in thickly. During its younger years it may need more pruning than most other native trees, but with age the strong leading shoots will obtain the greatest amount of sap and nourishment, while the side branches will decrease in rapidity of growth. What is termed a "double leader" should in all cases be avoided by removing all but one upright branch, selecting, of course, the stronger



(Plate 29. See pages 157 and 206)

Mature, Mountain Form of Silver, or White Maple. Clearfield County.



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and the straighter to remain. Plantations of the sugar maple in the north and west, intended for sap in the manufacture of sugar and syrup, must be set at a sufficient distance apart to permit the trees to develop, similar to an orchard of fruit trees.

WHITE MAPLE, SILVER MAPLE.

(See Plate 29).

(*Acer dasycarpum*). (Sargent, Silva N. A., *Acer saccharinum*, Vol. II, p. 103, t. 93).

Although of very rapid growth, this species is decidedly inferior as an ornamental tree to all others of the family. It is entirely too large and coarse for street planting, and is also liable to be split and broken by storms. The wood, however, is soft, white and easily worked, so that it affords in a short time a good supply of cheap lumber. The ease with which it may be increased, its rapidity of growth, adaptation to almost every variety of soil and perfect freedom from disease and injurious insects, entitle it to some respect. It will succeed on light, thin soils, but not with the remarkable luxuriance that is so common in deep, rich ground. The seeds are ripe early in June, when they may be swept up under the trees and planted as soon thereafter as possible. The common practice is to plow and harrow a strip of ground, leaving it mellow and devoid of stones and clods. Shallow furrows should then be run out about three feet apart, and the seed scattered thinly along the drill. Cover lightly with an iron-toothed rake, when in a very short time the young seedlings will appear. The only cultivation necessary is that given to potatoes or beans, which is simply running the horse-cultivator between the rows occasionally and keeping the weeds in subjection among the young and tender plants. In the succeeding spring the seedlings should be from one to two feet in height, and may be transplanted to their permanent home. They grow rapidly from the start, but in case any incline to be crooked or too thickly branched, it is advisable to cut them down to within a few inches of the ground, when a strong young sucker will at once start out and soon form a perfect tree. This system is in vogue with many of our best practical nurserymen, who have a habit of cutting all their young plants of two seasons growth to the surface of the ground, realizing the fact that the sucker always forms a perfect tree, and that no time is lost by the operation. There is a very distinct and handsome variety of this species in cultivation known as

"Wier's cut-leaved maple." The foliage of this is so deeply divided as to resemble the fronds of a fern, while the branches are slender and drooping, thus imparting a peculiar and attractive appearance very desirable in an ornamental tree. It is reproduced by budding on thrifty young seedlings of the common silver maple, which readily unite and form nice trees in a single season.

RED MAPLE, SWAMP MAPLE.

(*Acer rubrum*). (Sargent, *Silva N. A.*, Vol. II, p. 107, t. 94, 95).

A native tree to which we can give unqualified praise for its many excellencies. Either as an ornamental tree in our pleasure grounds, or for forestry planting it is of equal value, and no mistake can be made when used for either purpose. The common name of swamp maple is rather misleading, as one unacquainted with its cultivation is apt to believe that it will only thrive in low, wet grounds. Experience teaches that its natural location is the result of seed-germination, which in this case is more successful in damp soil. On the other hand, this beautiful maple is really more thrifty and vigorous where the ground is inclined to be dry, but at the same time deep and rich.

It is a mistaken idea to suppose that it is a slow grower, as with generous culture young trees in nursery rows develop as rapidly as the sugar maple, and frequently surpass the latter. It is also erroneous to suppose that the outline is not as regular as the other species belonging to this genus, as not infrequently specimens may be observed with perfectly rounded heads and straight trunks, which are unsurpassed for regularity and excellence.

The chief charm of this tree as a striking feature in our parks and pleasure grounds is its brilliant commingling of colors in its autumnal foliage. A group of these, with perhaps each individual displaying an entirely different tint, is exceedingly attractive.

The richest shades of scarlet and orange, with countless tints of each, may always be observed where these are common. In very early spring, the numerous flowers, varying from tawny yellow to bright purple, add still another pretty feature to an otherwise excellent ornamental tree. The timber of the red maple is hard, and frequently of exceeding beauty when polished, especially the formation known to cabinet makers as "curled or bird's eye maple," and is in great demand. For the first few years care must be taken to remove all large limbs, as with age these will interfere with the value of the lumber. After the trees are of sufficient size to shade each other, especially the trunks, very little pruning will be necessary.

The seeds are very abundant on some trees, and should be collected and sown in beds as soon as possible, giving them a slight covering of light soil, and shading them with brush to prevent drying out. A few old leaves scattered over the surface answer an excellent purpose, as this species more than any other is impatient of drought in its earlier years.

A damp location for the beds will also induce germination, and impart vigor to the young plants. The seedlings do not make a very strong growth the first year, so it is advisable to permit them to remain in the bed for two years; after which they can be transplanted to the field rows as recommended for others of the genus.

BOX-ELDER, ASH-LEAVED MAPLE.

(*Negundo aceroides*). (Sargent, Silva N. A., *Acer Negundo*, Vol. II, p. 111, t. 96, 97).

An ornament to our grounds, the chief merit of this tree consists in rapidity of growth and adaptability to almost any variety of soil, no matter how dry. In the earlier stages of its growth it is by no means objectionable, but with age it becomes unsightly and deformed. The foliage commences to show signs of decay by midsummer, owing perhaps to the presence of a destructive fungus, which is increased by the action of intense heat at that season. In the west, on the treeless plains, the box-elder has given universal satisfaction, succeeding even almost where every other tree has proved a failure. For this reason it is advisable for our tree-planters to give it a fair trial in localities where the better class of forest trees refuse to succeed, and where its quick growth and easy culture will doubtless prove remunerative.

Its production from seed is very easy, merely collecting when ripe and sowing at once in beds as directed for other trees before mentioned. The seedlings will be sufficiently large in one year to set in rows, and will then grow so fast as to need very little care of any kind. This tree was classed with the maples by Linnaeus, the great father of botany, but modern scientists have separated it therefrom, mainly on account of the pinnate leaves, that is, several leaflets joined to one long common stem, as in the ash, walnut, etc., etc. It also differs from the true maples in producing its sterile and fertile flowers on different trees.

COMMON LOCUST.

(*Robinia Pseudacacia*). (Sargent, Silva N. A., Vol. III, p. 39, t. 112, 113).

This well-known tree combines the two attributes of perfection that should entitle it to consideration for any purpose, but, unfortunately, the attacks of a species of beetle peculiar to this locust have of later years greatly discouraged planters. It is at once an exceedingly beautiful tree when in bloom, as well as a very useful one, on account of the value of its timber. The delightful fragrance of its flowers and its remarkable rapidity of growth are additional incentives to lovers of trees to experiment, in the hope that the destructive larva may find some more congenial home where its ravages will not prove so disheartening. Another important quality in our locust is, that like the chestnut, a plantation of mature trees may be cut away when a young grove of the same will at once take its place, with this distinction, that the former will reproduce itself by the aid of suckers from the roots (so called, but actually underground branches), and the latter from suckers that start out from the stump. In either case, the second crop of trees will reach maturity much sooner than the original plantation. The reproduction of this species may be from transplanted suckers or, if needed in large quantities, by the agency of seed. The seed, which is produced in legumes or pods (as for instance the pea or bean), may be thrashed out with a flail when perfectly dry and ripe, and then cleaned through a winnowing fan. It may be sown at once in the autumn, or preserved dry until spring. If the latter is preferred, the seed must be soaked in hot water for forty-eight hours, on account of the hard shell or covering. If sown in autumn, there is considerable risk from field mice, which are very partial to the taste of locust seeds. Sometimes this species is slow in germinating, as is the case with all bony-shelled seeds, so that if these do not show as soon as most other tree seedlings, the propagator need not feel discouraged. The young plants are readily removed, although sometimes they are not sufficiently large at one year, but the second year they will partake somewhat of the character of the fabled "Jack's Bean Stalk," and make an astonishing growth. It is seldom the locust needs the aid of a pruning knife, excepting when the young tree assumes a forked head, and then it is advisable to remove the weaker shoot.

KENTUCKY COFFEE-TREE.

(*Gymnocladus Canadensis*). (Sargent, Silva N. A., *Gymnocladus dioicus*, Vol. III, p. 69, t. 123, 124).

Another member of the large and important Natural Order of "Leguminosae" or Pulse family of trees and plants. From an ornamental point of view this species is of considerable importance, as its peculiar habit of growth is quite distinct from all others. It is never a beautiful, but at all times a picturesque specimen of forest-growth. Consequently, for use in landscape gardening, it has its value in certain positions, as, for instance, a solitary tree on the lawn, or as a centre in a group of round headed foliage. The peculiarity of growth has given to the Kentucky coffee its generic name, which is derived from two Greek words signifying a naked branch. It is very tall when standing in deep alluvial soils, and forms an ideal tree for lumber. The wood is firm, strong, and of a dark color, taking a beautiful polish; hence, it has not been inaptly termed North American mahogany. The long, flat pods with which the tree is clothed in autumn, present a peculiar and striking appearance, not at all unpleasant to the eye, and are valuable as a means towards increasing our stock of plants for forest purposes. These pods are several seeded, the latter incased in a gummy substance, and can only be forced to give up their contents expeditiously by permitting them to freeze hard before collecting, and then thrashing with a flail. The hard flattish seeds may be sown at once, or preserved dry until spring, when they must be soaked in hot water for forty-eight hours, and sown in drills like garden beans. This species need not be planted as thickly as some others, owing to its large size and rapidity of growth.

It needs little if any pruning, on account of the scarcity of branches, which gradually disappear as the tree increases in size. In proper congenial ground the Kentucky coffee should prove to be one of the most remunerative forest trees we could select for timber purposes.

HONEY LOCUST.

(*Gleditsia triacanthos*). (Sargent, Silva N. A., Vol. III, p.75, t. 125, 126).

Another useful tree, very closely allied to the last, although different in growth and general appearance. It is also of very large size, of rapid growth, and forms a rounded spreading top. The foliage is especially graceful and delicate and very abundant, being what botanists term "twice-pinnate" leaves. Notwithstanding its preference for rich soil, in which it makes astonishing growth, it takes kindly to almost any situation, provided the ground is not very poor. The only objection that may be offered to its use as an ornamental tree, is the number of large sharp thorns with which every portion of the trunk and branches is supplied. Its value as a hedge plant is thoroughly appreciated by our agriculturists, although it is a gross feeder, and speedily extracts all nourishment from the soil in its vicinity. Still, it is not the ideal plant for hedging, as possibly no large tree can ever gain pre-eminence in this respect. It is difficult to keep in subjection, and soon exhausts the soil, so as to require feeding, else the hedge will turn yellow and speedily deteriorate.

The instructions given for saving the seed and growing young plants of the foregoing species, are equally applicable to this and very little difficulty need be apprehended. The young seedlings are generally furnished with long tap-roots. Therefore as an aid to the planters, it is advisable to cut off a portion before "dibbling" in the ground. In fact, with all kinds of seedlings, this system of curtailing the long tap-roots is preferable to bending them horizontally during the transplanting process.

WILD BLACK CHERRY.

(*Prunus serotina*). (Sargent, Silva N. A., Vol. IV, p. 45, t. 129).

A valuable but neglected native species, quite common in a wild state, but almost unknown in cultivation. Certain it is that much less worthy trees are usurping the position that could be far better filled by this meritorious American species. It is a tree whose usefulness is not limited to any special duty, being equally profitable in the plantation of timber growth, or on the highly cultivated lawn.

The outline and general appearance of this tree is very graceful and susceptible of creating pleasing effects when in a group of lighter colored foliage. The deep shining green of the leaves, with an abundant drooping racemes of pure white fragrant blossoms in May, or strings of dark purplish fruit in August, are deserving features in an ornamental tree. The tent caterpillar apparently selects the wild cherry for a home in preference to any other tree, but it should always be dislodged as soon as noticed.

The propagation of this species is comparatively easy, provided a few necessary principles are observed. As soon as ripe, the fruit, called by botanists "drupes," must be washed to remove the pulp from the hard bony covering of the seed. The latter may then be sown at once in drills, or what is better, preserved in a box of sand until spring. Some propagators set the box in a cool, damp cellar, but others, believing in the efficacy of frost, place them in the open air, merely fastening a board over the top as a protection against soaking rains and snow. In either case, it must be borne in mind that the depredations of mice are to be guarded against, especially during winter when food is scarce. If sown thinly in drills, whether in autumn or spring, the seedlings will soon appear above the surface after a few mild days have somewhat warmed the soil. The usual advice given for the preceding trees will answer as well for the wild cherry; namely, to cultivate frequently, and keep down all weeds. At two years of age, the seedlings should be of sufficient size to remove to the permanent plantation.

The timber of this species is of the utmost importance in the mechanic arts. The color, a pale reddish brown, is very beautiful in a polished state, and is annually becoming of more importance, and naturally commanding a higher price. Says Dr. Darlington in "Flora Cestrica," "The bark though a rather unpalatable bitter, is a good tonic; the leaves are a favorite food of caterpillars, and the ripe fruit is greedily devoured by birds."

SWEET GUM TREE.

(*Liquidambar styraciflua*). (Sargent, Silva N. A., Vol. V, p. 10, t. 199).

One of the most desirable ornamental trees in cultivation, although rather more difficult to remove than some others. In favorable situations it is of the largest size, with a handsome rounded top, curious corky bark and deep green, shining, starlike foliage. In the autumn the leaves change to bright red and are exceedingly attractive. Although partial to moist, rich soils, it will succeed in any

situation if not devoid of plant food, or on very dry, sandy hillsides. The lumber furnished by this species is fine-grained and of value, although inferior to many others. The large size of the trunks, from fifty to seventy-five feet in length, and a diameter of two feet, with scarcely a limb to mar their symmetry, renders them of importance to the forester. The seeds are inclosed in a woody globe and fall from their covering at maturity, when they must be collected and sown in beds immediately. The soil should be nicely prepared and raked fine, and the seed sown thinly and covered lightly. It is best to protect the surface with a slight coating of leaves. Two years at least will be required to grow the plants sufficiently large for transplanting, and great care must be taken to preserve the roots moist while out of the ground. As a precautionary measure, set the seedlings rather thickly in the rows, thus providing for a suitable thinning-out as the trees increase in size. Indeed, the Liquidambar needs to be grown sufficiently close to throw a deep shade, and prevent the formation of large side limbs.

DOGWOOD.

(*Cornus florida*). (Sargent, *Silva N. A.*, Vol. V, p. 66, t. 212, 213).

For ornamental purposes this small-sized tree is of the greatest importance. Either as a solitary specimen, or grouped along the edge of a clump of large trees, it is at all times a conspicuous object. The large and showy "involucre" (covering of the true flowers) is mostly snow-white, and apparently clothes the entire tree during the month of May; and in September it is again decorated with a profusion of bright red fruit. The autumnal tints of its foliage are of the most gorgeous description, being usually a brilliant crimson.

If young trees are removed from the woods, it is an excellent plan to permit them to become well rooted in their new home, and then cut the entire top to within a few inches of the ground, when one or more suckers will generally appear. Select the strongest and straightest of these to form the new tree, and carefully remove all others at the earliest opportunity, and a shapely tree will be the result. But trees raised from seed in the nursery are always to be preferred, and when planted in the full sun will always prove more desirable in the end. As a timber tree, although of small size, our dogwood has not received the encouragement that its merits deserve. The wood is hard, close-grained, and of great importance in

the mechanical arts, being susceptible of taking a beautiful polish. The seed is covered with a fleshy coat, which must be soaked in water and carefully rubbed off, when they should be packed away in damp sand in a box and buried in the ground until spring. Early in the season, in fact as soon as the soil may be worked, the seed should be sown in beds of rich, moist soil, and they will not be long in germinating. It has been found advantageous to scatter a slight coat of old, well-rooted manure over the surface of the beds, thus preserving the soil cool and moist, as well as supplying plant-food to the young seedlings. These may remain in the beds for two years, as they increase in size very slowly at first, although with good cultivation afterward, they grow satisfactorily. It is a tree that will succeed in partial shade better than most trees. Consequently, in the first removal, the young plants can be placed rather closer together than the large growing species.

TUPELO, BLACK, OR SOUR GUM.

(*Nyssa sylvatica*). (Sargent, Silva N. A., Vol. V. p. 75, t. 217, 218).

Another native tree of medium or large size whose cultivation has been almost entirely neglected heretofore, and yet it is susceptible of creating beautiful effects in landscape art. If growing in low, moist, rich soils, it makes a picturesque top, with the branches horizontal and drooping, with dark green, shining leaves that change in autumn to a brilliant crimson. Fruit plum-like (drupes), inclosing a one-seeded stone with a very hard bony shell. The texture of the wood is proverbial, and has given rise to the apt expression, "As tough as a gum-tree log." The woody fibre is very close-grained, twisted and interlocked, and cannot well be split apart. On this account it is found serviceable in the manufacture of certain articles requiring this very texture.

The fruit should be gathered when fully ripe in September and October, and after subjecting it to a thorough soaking and washing it may be treated precisely as recommended for dogwood, the fruit of which is quite similar in character. Although the *Nyssa* will grow on high dry soils, it will not attain the luxuriance that moisture and a deep rich soil invariably impart to it, and on this account the latter location ought always to receive the preference. Notwithstanding its inclination to branch low, trees of this species will run up a fairly straight trunk if planted thickly.

PERSIMMON.

(*Diospyros Virginiana*). (Sargent, Silva N. A., Vol. VI, p. 7, t. 252, 253).

A very variable tree in size, ranging according to the situation from twenty to sixty feet in height. This is not a specially useful species for ornamental planting, partaking more of the picturesque than the beautiful, although if a proper selection is made, it is worth cultivating for the fruit. The latter, as is well known, is very astringent when immature, but after being well frosted is sweet and edible. The fruit is really a large, yellow, many-seeded berry, and the seeds are not at all difficult to germinate if preserved over winter in boxes of moist sand, in a cool cellar, after being washed clean of the surrounding pulp. In early spring they should be sown in drills, rather thinly, and receive a careful cultivation to prevent being stunted. The idea is to keep them growing as strongly at first as possible, when their removal to the forest will be an easy task. The wood partakes somewhat of the character of its near relative ebony (*D. Ebeneum*), being very dark, with a very hard, fine-grained texture. The generic name is rather exalted for so poor a subject. It is derived from two Greek words signifying "Jupiter's Fruit." The recently introduced Japanese persimmons are wonderful improvements on our native species in the dimension and quality of the fruit, specimens being grown in the Southern states the size and color of oranges.

WHITE ASH.

(*Fraxinus Americana*). (Sargent, Silva N. A., Vol. VI, p. 43, t. 268, 269).

A grand native tree of large size and imposing appearance. With sufficient space to develop, this is decidedly one of the most valuable species for ornamenting parks and large pleasure grounds, as the conspicuous gray bark and light, graceful foliage render it very useful as a contrast to darker hued trees. For forest planting it may well be recommended, as the stems usually grow to a great height, perfectly straight, without a limb, except near the summit. The wood is valuable, and readily commands a good price in the market.

Its cultivation is comparatively easy, the seeds being readily germinated and the growth of the trees rapid, although it is somewhat particular in regard to the quality of the soil. The seeds are not unlike those of the maple in general character, being what are called "keys" or "samaras," and should be collected as soon as ripe and sown in nicely prepared beds of light soil. As they prefer a little moisture to influence germination and induce growth in the seedlings, it is well to provide a slight shade over the beds at first, until the plants have become thoroughly rooted. At one year old the seedlings may be removed to their future home. They are not usually difficult to transplant, being provided with a good supply of rootlets. This operation may be deferred until some of the species that start early into spring growth have had attention, as all this family are about the last to vegetate.

The other American species belonging to this genus are inferior to the above, although sufficiently meritorious to receive attention at the hands of our foresters. The red ash (*F. pubescens*) is a small tree, with inferior wood, and yet it is rather ornamental in moist, rich soil. It is not very common with us, and is scarcely ever found in the western portion of our State. The green ash (*F. viridis*) is a small sized tree, seemingly taking the place of the red ash in localities where the latter is rare or not to be found. It forms a valuable and pretty little tree on the lawn, with bright green foliage. The timber is about as good as the white ash, but the trunks are much less in size. The seeds of this species may be preserved dry until spring, and then sowed thinly in light moist soil. The black or water ash (*F. sambucifolia*) says Dr. Darlington, "is the least common, the least in size, and the least valuable, of the three species here enumerated" (green ash not included). Notwithstanding it is commonly found in wet situations, it appears to thrive in dry soils, and may prove remunerative for forest growth in limited numbers. Its propagation is similar to that recommended for the white ash.

CATALPA.

(*Catalpa bignonioides*). (Sargent, Silva N. A., *Catalpa*, Vol. VI, p. 86, t. 288, 289).

Is a native of the Southern and Southwestern states, but will succeed with us after the young trees have become somewhat matured. The only fault that can be found with it as an ornamental tree, is the accumulation of leaves, pods and decaying flowers, too frequently

noticed on the ground in its vicinity. After having become established and duly pruned into shape, the catalpa is a decided addition to our cultivated grounds. The form is picturesque in its uneven outline, the leaves are large and conspicuous, and the flowers arranged in huge compound panicles are very attractive. It is not particular regarding a choice of soils, and will grow thriftily in low wet land as well as on a dry sub-soil, although it will attain much greater perfection in the former.

As a timber tree our planters cannot well make a mistake by selecting it in preference to some highly-lauded species, especially on ground so wet that most others would not thrive. The wood is very valuable, light and susceptible of taking a beautiful polish. Its durability is almost unsurpassed, especially when set in the ground as fencing material. In suitable locations it grows rapidly and to a considerable height, and by judicious pruning at first will grow reasonably straight. The seeds are small and surrounded by a thin fringed wing. They are contained in long slender pods that split open at maturity. The seed should be gathered and preserved dry until spring, when it may be scattered very thinly over the surface of a nicely prepared bed, and covered lightly with finely pulverized sandy soil. The seeds soon vegetate and grow rapidly, and in one year will be ready to plant out in rows. This tree may also be grown from cuttings of the hard wood, say, about nine inches in length, and planted in very early spring. Only the top bud should show above the surface of the soil, and the tighter the soil is rammed around it, the greater the success will be. For the first few years the Catalpa is liable to have its top winter-killed, and in such cases it is advisable to cut the young sapling to the ground and permit a fresh body to form, that will be, in most cases, straight.

Of later years a western species of this genus has been identified and cultivated under the name of *C. speciosa*, that is said to attain a larger size than the preceding, with a straighter trunk and more symmetrical proportions. Western planters are using it in preference to the former, as it is believed to possess a hardier constitution and is better fitted for forestry purposes. In Lancaster county, Pennsylvania, one year old seedlings set in 1882 are now, after twelve years growth, from twenty-five to thirty feet in height, and twelve to fifteen inches in diameter at the surface of the ground.

SASSAFRAS.

(*Sassafras officinale*). (Sargent, Silva N. A., *Sassafras Sassafras*, Vol. VII, p. 17, t. 304, 305).

A small and medium sized tree with fine-grained wood of very doubtful durability. As an ornamental tree, when well grown, it is attractive and possesses an element of beauty peculiar to itself. The leaves are rather large, ovate or three-lobed, and glabrous, changing in autumn to a bright yellow tint. The bark is highly aromatic and spicy, especially that of the roots, which is frequently used for flavoring mild drinks, etc. Formerly, the medicinal properties supposed to exist in the mucilaginous products of this tree were greatly esteemed, but of later years there is little respect paid to them.

The seeds are inclosed in a drupe, the fleshy covering of which must be macerated in water until easily removed. They must be planted at once in beds of light, rich soil, for if permitted to become dry they may not germinate for two years. The customary two years will be none too long for the plants to remain in the beds before removal to their final quarters. If readily obtainable, it will pay to give the seed-beds a slight covering of leaves or saw-dust, for the purpose of preserving the moisture in the soil. When needed in limited numbers the sassafras may be procured from suckers that are usually found growing around old trees. Its reproductive powers are wonderful in this way, and if a young tree should prove unsatisfactory at any time, the root will invariably force a new stem if the tree is simply cut to the ground.

AMERICAN ELM, WHITE ELM.

(*Ulmus Americana*). (Sargent, Silva N. A., Vol. VII, p. 43, t. 311).

In the New England States this is "par excellence," the ornamental tree best suited to the locality, and although it succeeds admirably in Pennsylvania, it does not reach the majestic proportions nor assume the charmingly graceful habit that are its marked characteristics in its Northern home. Still, we have few more beautiful shade trees than this, and no one makes a mistake in selecting the white elm, provided he can command sufficient space to permit its full development. A few years ago, owing to the depredations of in-

sects on the foliage, this genus of trees bid fair to be shortly exterminated, as in most cases the leaves were wholly skeletonized by midsummer. Fortunately, through the instrumentality of some species of Ichneumon Fly preying upon them, or from some other unknown cause, these pests have almost entirely disappeared. It is a tree of great size, and although the wood is useful for many purposes, it is not very durable or highly esteemed. However, it grows rapidly, lives to a great age and is readily transplanted. Although not very particular in regard to location, it is best adapted for low, rich and moist soils. It will live on high, dry hillsides, but under such conditions it never develops into the grand specimens that we so much delight in. Its reproduction is almost entirely from seeds, yet layers of the young shoots will root speedily. The seeds that ripen in spring should be sown, as soon as gathered, in a bed of sandy soil, and shaded from the hot rays of the sun for the first year.

If moisture can be supplied artificially, germination will be greatly accelerated, and the seedlings receive a good start. In two years time they should be of sufficient size to transplant.

SLIPPERY ELM.

(*Ulmus fulva*). (Sargent, *Silva N. A.*, Vol. VII, p. 53, t. 314).

Sometimes known as red elm, and is more valuable than the above for timber, although it is of a smaller size and is, at best, only a medium sized tree. It cannot be recommended very highly as an ornament for the lawn, and yet it is not objectionable for that purpose, but the merits of its near relative, the white elm, are so much superior that the latter is seldom, if ever, employed. The wood of the red elm is rough, of a reddish tint, and much superior to others of the family, although not very durable when exposed to the weather.

It is usually found in low grounds and will succeed in wet locations, yet where the tree is placed on high elevations it seems to thrive quite well. The inner bark abounds in mucilage, and is admitted to the "*Materia Medica*" as possessing valuable qualities. Its propagation is similar to that recommended for the white elm, with, perhaps, rather more necessity for preserving the seed-bed moist and shaded, both before and after the young plants appear above ground.

HACKBERRY, SUGARBERRY.

(*Celtis occidentalis*). (Sargent, *Silva N. A.*, Vol. VII, p. 67, t. 317).

A small, to medium sized elm-like native tree with small plum-like fruit (drupes), the fleshy covering very thin, but sweet and edible. A variety of larger growth with thicker and coarser leaves is also rather common in some sections, and is known as "var. *crassifolia*." It is not a very strikingly ornamental tree, although hardy and useful in a large collection. A rich, deep soil is essential for its perfect development, and in no other will it attain perfection. The lumber is not of special importance. It is white in color, however, and readily split. It speedily decays in the open air and is unsatisfactory for in-door work. The seeds must be sown in autumn as soon as mature, and will not always germinate the first year. The after treatment is similar to that recommended for the elms.

RED MULBERRY.

(*Morus rubra*). (Sargent, *Silva N. A.*, Vol. VII, p. 79, t. 302).

A small or medium sized species, producing the well-known blackberry-like fruit, which is preferable to that of any other species. Under favorable conditions, it develops into a handsome tree with rather large (especially when young) heart-shaped leaves of a deep green color, and a regular round head. In low, rich soil it grows quite rapidly, and yields a valuable quality of timber. This is commonly admitted to be durable and strong and will amply repay the forester for its cultivation, especially as it delights in partial shades. When fully ripe, the seeds may be washed clean and kept dry until spring, then sowed on a nicely prepared bed of light soil, covering the same very thinly with fine sandy earth. Mulberries may also be grown from layers, or cuttings of the ripe wood made during winter, preserved in soil and set out very early in the spring. The comparative ease with which it is raised from seeds, however, and the large quantity of plants that may be obtained in a short time by this method, are sufficient inducements to give it the preference.

BUTTONWOOD.

(*Platanus occidentalis*). (Sargent, Silva N. A., Vol. VII, p. 102, t. 326, 327).

One of our largest native trees, but inferior to the European species, *P. orientalis*, as an ornamental specimen. The blighting disease so prevalent on our tree, originating doubtless from the presence of some parasitic fungus, is to be deplored. Its well-known majestic proportions, picturesque appearance and hardy character would otherwise place it in the front rank of shade trees for cultivated grounds. As a timber tree, it is not of much value, as the wood is inferior in many respects; it warps badly, decays quickly and is of little value for fuel. The seeds are small nutlets, gathered together in a round ball, and may be collected as soon as ripe and sown immediately in nicely prepared beds of good soil, with a slight covering. The buttonwood family may also be increased from cuttings of the hard wood in autumn and placed in the open ground until spring, when they may be set thickly in rows, and a large proportion will form roots.

BUTTERNUT.

(*Juglans cinerea*). (Sargent, Silva N. A., Vol. VII, p. 111, t. 330).

A medium sized species with a round, spreading head, gray bark and downy leaves. It may be cultivated for its nuts or for timber, but it is not especially valuable as an ornamental tree. It is partial to low, moist, rich grounds, and in such grows rapidly and soon becomes profitable. The wood is soft, readily worked, and of a handsome light brown tint. All the walnuts are propagated from seeds that are best sown in autumn, merely crushing the "hull," so-called, and sowing all together in furrows made by the plow, about three feet apart and two or three inches deep. The seedlings will show above ground quite early the ensuing spring, and must be transplanted to their final home when one year old. If the long, radical root is shortened at the time of removal, side-roots will be induced to grow, and a larger percentage of the young seedlings will live. All this family are impatient of removal, so that some tree-growers prefer to plant the seed where the trees are to remain.

BLACK WALNUT.

(*Juglans nigra*.) (Sargent, Silva N. A., Vol. VII, p. 118, t. 331, 332).

A larger, handsomer and more valuable tree than the preceding, with dark-colored wood that takes a beautiful polish when old. It is a grand stately tree for large lawns, produces large crops of edible nuts, and is of the greatest importance for timber.

As it grows rapidly and is easily propagated from seeds, our foresters should turn their attention to it in preference to many trees of doubtful merit, too frequently recommended for the purpose. The suggestions given for growing the above species are just as applicable to the black walnut, with the necessary caution that due regard must be paid to trimming the young trees to a straight stem, as it is very prone to branch early and frequently. In a late number of "Garden and Forest" the following item appears: "Mr. Robert Douglas writes that black walnut trees, when set thinly in a plantation of *Catalpa speciosa*, made as rapid upward growth as the *Catalpas* until they reached a height of thirty feet, while in a small block planted of black walnut exclusively, the trees at the same age were not twenty feet high."

SHELL-BARK.

(*Carya alba*.) (Sargent, Silva N. A., *Hicoria ovata*, Vol. VII, p. 153, t. 346, 347).

It is strange that so remunerative a tree as this should receive so little encouragement on the part of planters in this country. Embracing all the requisites of an exceptional forest tree, saving perhaps that of rapid growth, it is rarely selected, and then only as a solitary specimen in some out of the way spot, as if it were a matter of the smallest importance. Whether for timber purposes, or for its valuable nuts, the shell-bark is fully entitled to our earnest attention, and when its value is once appreciated we shall doubtless observe extensive plantations, equalling in area the many worthless orchards that annually fail to compensate their owners for the ground they occupy. It is a tree of very large size and even proportions, consequently is an attractive object on the lawn, especially when young. The wood of this species, as well as that of all others be-

longing to the hickories, is of the greatest importance, not only in the mechanic arts, but as fuel. For the latter purpose it is doubtless unsurpassed, and always commands the highest price in the market.

Soon after ripening, the nuts must be collected, packed at once in damp sand and stored away for the winter in a cool, damp cellar, protected from mice. In early spring they must be scattered along shallow furrows in the permanent plantation, owing to the fact that all trees belonging to the "Juglandaceae" or walnut family, are exceedingly difficult to transplant.

Some propagators sow the nuts in autumn as soon as gathered, but the smaller animals are very destructive on them, consequently the risk is too great. The hickories grow quite rapidly for the first few years, but increase slowly thereafter. These hints will apply equally as well to the following species.

BIG SHELL-BARK.

(*Carya sulcata*). (Sargent, Silva N. A., *Hicoria laciniosa*, Vol. VII, p. 157, t. 348, 349).

A species closely allied to the last, but producing larger nuts, often measuring almost, if not quite, two inches in length, yet of inferior quality.

The timber of this is equal in value to the common shell-bark, but it differs in the heart-wood being lighter colored. It is almost exclusively a western tree, and not superior to the above for ornamental purposes.

WHITE-HEART HICKORY.

(*Carya tomentosa*). (Sargent, Silva, N. A., *Hicoria alba*, Vol. VII, p. 161, t. 350, 351).

Another large species of little value for its nuts, which have small, sweet kernels, encased in very thick, hard shells. The wood, both for fuel and manufacturing purposes, is fully equal to the shell-bark, and is white at the heart.

PIG-NUT HICKORY.

(*Carya porcina*). (Sargent, Silva N. A., *Hicoria glabra*, Vol. VII, p. 165, t. 352, 353).

Another large sized native tree quite common in our woodlands, with bitter nuts when at maturity. The timber is very tough and strong, and is preferred to any other for constructing many articles. The bark is rough, but not scaly, and the leaves smooth and shining.

BITTER-NUT HICKORY.

(*Carya amara*). (Sargent, Silva N. A., *Hicoria minima*, Vol. VII, p. 141, t. 340, 341).

This is perhaps the least valued of any of the family. The wood is soft but useful for fuel, and in good soil the tree grows to a large size, but it is more liable to destruction by insects than any other. The fruit is small with a thin shell, and an exceedingly bitter kernel. All the hickories are partial to low, rather damp situations, and rich, deep soils.

BLAOK BIRCH, SWEET OR CHERRY BIRCH.

(*Betula lenta*). (Sargent, Silva N. A., Vol. IX, p. 50, t. 448).

The group of birches here enumerated possesses so many valuable characteristics in common, that in referring to the various uses to which this particular species may be applied, the same suggestions appear almost equally applicable to all. They constitute a genus of trees remarkable for grace and beauty, airy lightness of foliage, elegance of habit, adaptability to various soils, and unquestioned hardiness. To these may be added handsomely colored wood of excellent quality, always in demand, and commanding remunerative prices. The black birch in congenial soil forms quite a large tree, with reddish-brown, highly aromatic bark and an attractive and

graceful habit of growth. The wood is fine-grained, rosy-pink in color, and of great value for cabinet-maker's work, and for fuel. Indeed, whether for use or ornament, it should be one of the first species to select. Its propagation is not attended with many difficulties. Where the adult trees are numerous, young plants can generally be obtained in quantity very cheaply. These may be gently pulled from the light yielding earth without injuring the roots, reset thickly in beds, and covered with evergreen boughs for the first season. But a small percentage of loss will result if the plants are preserved in a moist state when out of the ground. The seeds are very small, dry and winged, but must be sown at once on carefully prepared beds of fine sandy soil, and protected with leaves and a few pieces of brush to keep them in place. Moisture is a decided element of success, so that the beds ought to have a slight shade during the entire season.

If spring sowing should be preferable, then mix the seeds with damp sand and keep in a cool cellar until the soil is in proper condition early in the following April. Two years old seedlings are generally of sufficient size to remove to nursery rows or to the intended forest, which operation is mostly successful.

YELLOW BIRCH.

(See Plates 1 and 2).

(*Betula lutea*). (Sargent, *Silva N. A.*, Vol. IX, p. 53, t. 449).

Is somewhat similar to the above, attaining about the same size, but with silvery-gray or yellowish bark, distinctly marked leaves and not so aromatic. The wood is less valuable than the preceding both for lumber and fuel.

PAPER BIRCH, AMERICAN WHITE BIRCH.

(*Betula populifolia*). (Sargent, *Silva N. A.*, Vol. IX, p. 55, t. 450).

A small sized tree of graceful habit and striking aspect, but inferior to the white birch of Europe, of which ours has been considered but a variety. The wood is of poor quality, and not of much value even for fuel. Generally found growing along the Northern coasts on poor land.

CANOE BIRCH, PAPER BIRCH.

(*Betula papyrifera*). (Sargent, Silva N. A., Vol. IX, p. 57, t. 451).

A large, beautiful and valuable species, always conspicuous for paper-like white bark, which splits into fine layers. It is well adapted for ornamental purposes, and will succeed even where the soil is too wet for many other trees.

The timber is fine-grained and valuable, and its cultivation as a forest tree is to be highly recommended. Early in June the seeds will ripen, and may be sown at once in light, well prepared soil.

RED BIRCH.

(*Betula nigra*). (Sargent, Silva N. A., Vol. IX, p. 61, t. 452).

This species forms a rather large tree from fifty to seventy-five feet in height, with light-tinted foliage, whitish beneath, and greenish-brown bark. The wood is light-colored and of fair quality. The seeds ripen in June, and consequently should be collected and sown at once, when they will soon germinate if the ground is shaded and kept moist.

HOARY ALDER.

(*Alnus incana*).

A shrub or small tree growing naturally along streams, and from its Northern habitat, undoubtedly hardy. Notwithstanding it is too small for timber purposes, it is unquestionably of great use in holding the soil in position on embankments, etc.

It makes a charming little tree in damp ground, and is one of the few species adapted to planting in undrained localities. The roundish, sharply serrate leaves which are whitish beneath, and early blooming catkins, render this little species quite attractive.

The small seeds are ripe in October, when they should be gathered and sown thinly on the surface of carefully prepared, fine, sandy soil. The covering should be shaken over them through a fine sieve, being careful not to cover deeply, and then apply a slight coating of leaves and small branches. During the first season they must be shaded from the sun, either by lath-frames or branches raised a few inches from the surface of the bed. The smooth alder (*alnus serrulata*) is nothing more than a large shrub from six to ten feet high, found growing in swamps and low grounds, and is also useful for the same purpose as the above. Its propagation is similar in every way.

WHITE OAK.

(*Quercus alba*). (Sargent, *Silva N. A.*, Vol. VIII, p. 16, t. 356, 357, 358).

Perhaps the most important native tree to the Northern states, and valuable for any use to which a large sized specimen may be applied. It is of the greatest importance for parks and pleasure grounds of considerable extent, as its noble proportions and majestic appearance impart an air of grandeur to the landscape unobtainable from almost any other tree. It is generally accounted a slow grower, but in fairly good soil and with some cultivation for the few first years, it increases quite rapidly in size. The quality of its wood for almost any purpose is so well known that it is unnecessary to recapitulate it here; but even in a young state, when it becomes necessary to thin out growing plantations of oak-timber, the saplings have a pecuniary value. The seeds or acorns are to be collected as soon as ripe, placed in boxes of damp sand and assigned to a moderately cool, dry place until early spring, when they may be sown in beds. The young plants will quickly appear above ground, and will require no attention excepting an occasional weeding and hoeing to loosen the soil. In two years time, they may be planted in rows similar to those recommended in speaking of other large trees. It is better to set rather thickly, as the trees may be thinned out and disposed of for poles when they are but a few feet high. If too great space is allowed, they will commence to branch low and thus impair the value of the trunk, and it is desirable to secure a straight, naked stem as high as possible. Trimming, for this reason, must not be neglected, although in the case of "densely set" trees but little will be needed.

POST OAK.

(*Quercus stellata*). (Sargent, Silva N. A., *Quercus minor*, Vol. VIII, p. 37, t. 368, 369).

This sturdy little species long known in the botanies as *Quercus obtusiloba*, is commonly restricted to thin, barren or rocky ground. but is vastly improved when grown under more favorable circumstances. It has long been a favorite with the writer as an ornamental tree, from its robust, hardy character, and round compact head of rough, grayish, deeply-lobed leaves. Its timber is exceedingly durable, surpassing even the preceding species when used for posts, and is useful for all purposes where a tough, strong wood is desirable. It is propagated as above.

OVERCUP OAK.

(*Quercus macrocarpa*). (Sargent, Silva N. A., Vol. VIII, p. 43, t. 371, 372, 373).

This is also known as the bur-oak and mossy-cup oak in the western states, where it is quite abundant in some districts. It makes a handsome lawn tree, especially the form with corky, rough bark and very large leaves. For timber it is considered quite equal to the white oak, although usually not so large a tree at maturity. It is readily increased by means of its immense acorns, in the same manner as previously described for the type of this group.

SWAMP WHITE OAK.

(*Quercus bicolor*). (Sargent, Silva N. A., *Quercus platanoides*, Vol. VIII, p. 63, t. 380, 381).

A native of low lands, generally along the margins of streams, and forms a beautiful, large umbrageous tree both for ornament and timber, although inferior to the foregoing species for the latter purpose. It is not a member of the white oak section, as its common name implies, but properly belongs to the chestnut oak group. It is readily reproduced from seeds, and transplants with little loss.

ROCK CHESTNUT OAK.

(*Quercus Prinus*). (Sargent, Silva N. A., Vol. VIII, p. 51, t. 375, 376).

Of the several varieties of this species, what is usually known as the swamp chestnut oak is the largest and most attractive for ornamental work, but the form previously known in the books as "var. *monticola*" is superior for timber, and is remarkably heavy and strong, yet a much smaller tree than the above.

YELLOW OAK.

(*Quercus Muhlenbergii*). (Sargent, Silva N. A., *Quercus acuminata*, Vol. VIII, p. 55, t. 377).

This is the *Q. casteanea* of the old botanists, and is readily distinguished from the other allied species by the almost exact resemblance of the leaves to those of the chestnut, while the bark presents the appearance of the white oak. It is a medium sized, slender, beautiful tree and appears well with other species in cultivated grounds. The wood is strong and durable, of a yellowish tint, and worthy of a place in the list for forest planting.

RED OAK.

(*Quercus rubra*). (Sargent, Silva N. A., Vol. VIII, p. 125, t. 409, 410).

It is one of the most valuable shade trees wherever there is sufficient space to develop its beauty. Being not averse to poor soils, it is thus useful for locations where many of our finer species would be useless. The foliage, dark, glossy-green during the summer months, changes to a brilliant crimson in the autumn and is then a conspicuous and charming object. Unfortunately the timber is of little value, being coarse, open and not durable.

SCARLET OAK.

(*Quercus coccinea*). (Sargent, Silva N. A., Vol. VIII, p. 133, t. 412, 413).

It is certainly a first-class specimen for parks and pleasure grounds of any extent, forming a tall, shapely tree with beautiful, deeply-cut leaves, changing in autumn to the brightest scarlet. When young this species is of pyramidal outline with gracefully drooping branches, but with age the top becomes tabular and spreading, although it is never devoid of picturesqueness and beauty. Like the last-named oak, the timber is not durable and the tree is unworthy of cultivation for this purpose.

BLACK OAK.

(*Quercus coccinea*, var. *tinctoria*). (Sargent, Silva N. A., *Quercus velutina*, Vol. VIII, p. 137, t. 414, 415).

A mere variety of the preceding, although distinct in general appearance. This well-known tree is of large size, with rugged aspect and deeply-furrowed bark. It is not specially valuable for ornamental planting, except in extensive collections, although the large, deeply-lobed leaves of a dark, glossy-green color are not without a certain element of beauty. The wood is not much superior to those last named, excepting that it is more durable and stronger, notwithstanding its coarse grain, but the inner bark forms an article of commerce under the name of "quercitron."

PIN OAK.

(*Quercus palustris*). (Sargent, Silva N. A., Vol. VIII, p. 151, t. 422, 423).

By many landscape gardeners this species is preferred to any other of the family for perfecting their plans, and is widely used for avenues where it seems particularly appropriate. It has a character peculiar to itself and is readily distinguished from all others by its

drooping habit, tall, conical outline, and deeply-cut, glossy leaves. Notwithstanding it is commonly seen in low, moist grounds, it easily adapts itself to high and dry situations, and is always an object of beauty. Although reasonably tough and strong, the wood is not very durable nor of much pecuniary value. It is readily grown from seed as heretofore described.

Acorns, as a rule, germinate easily, provided they are not permitted to dry before placing in damp sand or soil. In fact, acorns of some species, as the white oak, and some of the chestnut oaks, will sprout even before falling from the tree, so that the young and tender radicle or embryo root must be preserved in a moist state to retard vegetation. Coarse, gritty sand has proven to be the best material to use for wintering seeds, followed by damp moss, while the most objectionable is ordinary soil, owing to its disposition to incite the growth of destructive fungi, in the form of mold, etc.

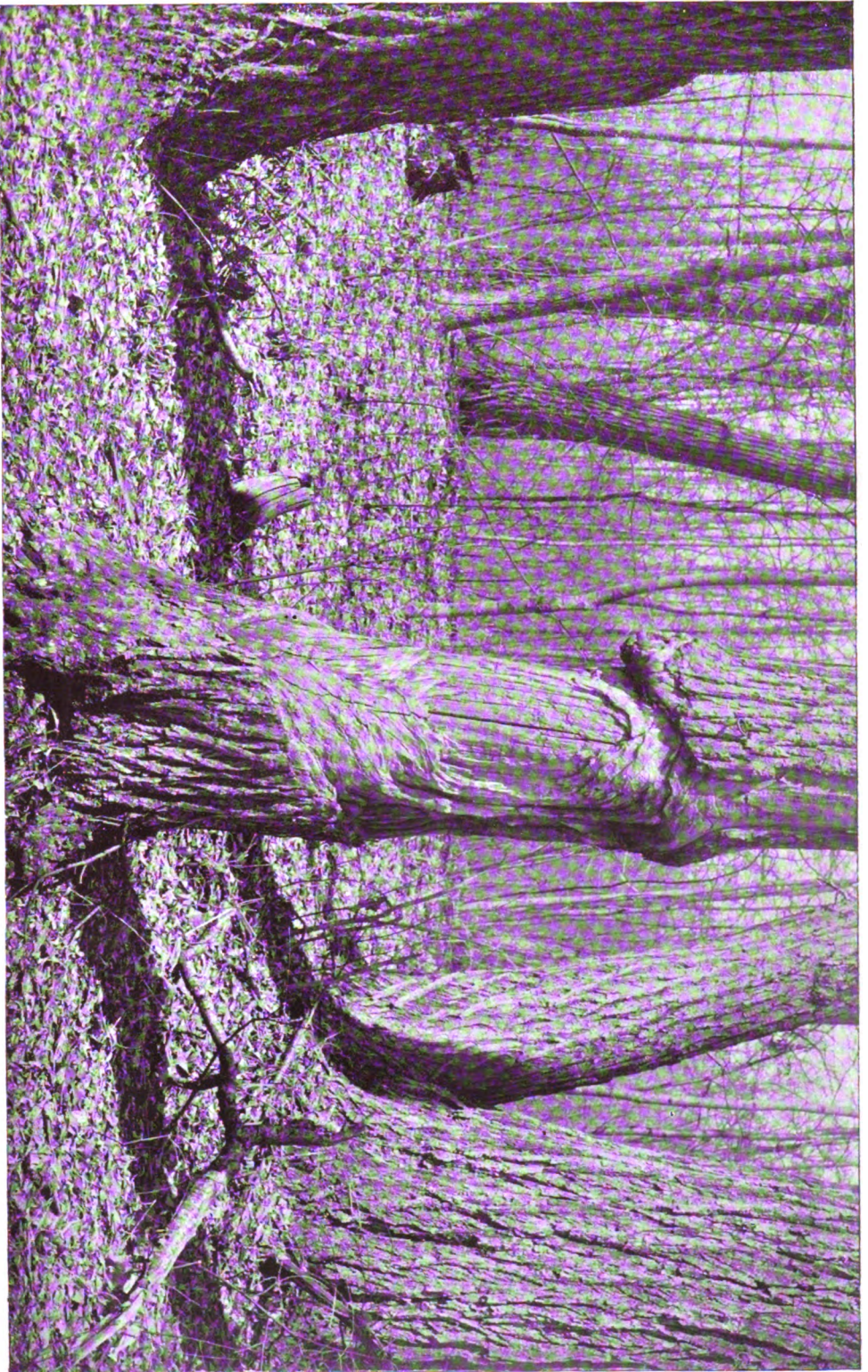
CHESTNUT.

(See Plates 30 and 32).

(*Castanea sativa*, var. *Americana*). (Sargent, *Silva N. A.*, *Castanea dentata*, Vol. IX, p. 13, t. 440, 441).

This valuable, well-known tree is too highly esteemed to require any eulogistic remarks upon its merits. It is sometimes used as an ornamental tree on the lawn, where its crops of edible nuts are an additional incentive for planters to use it more freely, and for timber it has few competitors for profit. The fact that it will thrive on thin, slaty soils, where most trees refuse to grow, greatly enhances its value. Indeed, it seems at home in any location, provided it is not too wet. The wood is coarse-grained, but light and durable, making unsurpassed fencing material. For fuel it is of little value. No other known tree in our climate will exceed this for timber purposes, taking into consideration all the requisites for success. As previously stated, it is adapted to almost all soils, is of very rapid growth, easily propagated in large numbers, very quickly comes into profit, is used for a great variety of purposes and the demand exceeds the supply.

The nuts must be collected as soon as ripe and immediately placed in moist, but not wet sand, and set away in a cool, damp cellar until the following spring, being carefully protected from mice. There is a trite saying among old gardeners, that if chestnuts are placed in one's pocket, germination will not take place. Of course, this is an exaggeration, but the principle of preventing the nuts



(Plate 30. See pages 182 and 259.)

Chestnut Tree, Barked by Horses, at Cain Meeting House, Chester County.

from becoming dry is intended to be enforced, hence there is a grain of truth in the adage. In preparing the seed-beds, it is well to have a certain proportion of sand mixed with the soil, or at least nuts and sand from the storage-boxes should be sown together in drills. They will grow in a few days after planting, if the weather should prove favorable, and if kept clean from weeds. The seedlings may be set in rows at the age of one year. Plant rather thickly in the row, say, two feet apart, as they may be thinned out at an early age and sold at a profit, to be used as poles for market gardeners, etc.

Some foresters recommend planting the rows eight feet apart, with a row of corn in the space between. This acts as a shade to the young trees, and at the same time yields an immediate return from the land. Another item to be credited to the chestnut, is the fact that after it has been cut, a crop of suckers will at once start out and quickly form a new forest without the necessity of replanting with fresh seedlings, as is the case with most trees.

AMERICAN BEECH.

(*Fagus ferruginea*). (Sargent, *Silva N. A.*, *Fagus Americana*, Vol. IX, p. 27, t. 444).*

This is one of our large native trees that has been much neglected, both for shade and timber. It has a grace and beauty entirely distinct from any other, and is certainly deserving a place in our larger ornamental grounds at least. The wood is valuable for many purposes, being dense, of uniform texture, very fine grain, and it may be highly polished. Although inferior to some others, by no means should it be despised for fuel. Other species will pay better for timber culture than the beech, as it is not a rapid grower, but in generous soil, contiguous to moisture, its annual increase is fairly good.

It may be reproduced by the same methods described above for the chestnut, and like the latter, will sucker freely from the root, if the timber is cut during winter.

* Sargent's *Silva N. A.* not being completed, cannot be further utilized on this list.

THE WILLOW FAMILY.

(See Plate 34).

SALICACEAE.

The arborescent species of this large and important family are of decided use to the cultivator of trees, especially to the owner of low grounds traversed by streams of water. They are of the greatest importance for preserving embankments from being washed away by floods, and the wood of some species being very light, white and easily worked, is in considerable demand for special purposes.

All things considered, perhaps the white willow (*salix alba*), introduced from Europe, is as profitable as any of our cultivated species, attaining large size, of rapid growth, and is the species mostly used in the preparation of charcoal for manufacturing gun-powder.

THE BASKET-OSIER WILLOW.

(*Salix viminalis*).

Another European species, is perhaps the most useful for basket work, although the brittle willow (*Salix fragilis*), and its form known as var. *Russelliana*, are also recommended for that purpose.

Willows are of the easiest culture; all that is necessary being to cut the young shoots into a suitable length, say, from nine to twelve inches, in early spring, and push them into the damp, yielding soil, almost their entire length. If the earth should be rammed tightly around them, success will be assured.

WHITE PINE.

(See Plate 35).

(*Pinus Strobus*).

Perhaps no other tree has so great a commercial value as this important pine. But as the vast area which was formerly clothed with white pine in this State is being rapidly reduced, it is becoming a serious problem for future lumbermen to solve, how to supply the

rapidly increasing demand for this species, notwithstanding the thousands of acres yet uncut in other states. As an ornamental tree it combines more excellencies than any other native conifer, and is highly deserving a position on every lawn of suitable size. For forest planting, however, it stands unexcelled in our entire list of evergreens; and when we take into account its rapid growth, hardy constitution, and adaptability to all soils not too wet, we should have no hesitancy about selecting it for even a small plantation. Of late years, in the eastern portion of the State, a peculiar blight has prevailed to a limited extent among our young white pines, which, upon investigation proves to be the result of some form of parasitic fungus, but whether this disease will be sufficiently serious to deter planters from cultivating it, remains to be seen. In an article published in "Forest Leaves" sometime ago, the writer described his method of growing conifers from seed, which in brief was as follows:

"Evergreen seeds of all description must be sown as early in spring as it is possible to prepare the ground. In fact, it is preferable to sow them upon a frozen surface than to delay the operation until the weather should be warm. Loosening the soil is unnecessary, but after scattering the seed thinly, a little light sandy soil must be shaken over them and the covering then pressed firmly by means of a board. The bed must be shaded from the sun by means of evergreens, or, still better, lath-frames. Extremes of drought and moisture should be carefully guarded against and of course no weeds must be permitted to grow. The greatest enemy of young seedling evergreen is what gardeners term 'damping off,' but this rarely happens after the true leaves show, and the stem commences to harden. The mischief is traceable to a fungus, and to guard against its deadly work, the plants should be well under way growing before the hot weather sets in." All conifers hereinafter described, may be grown in the same way as explained above, excepting that it is cheaper to procure some species from the woods, where the seedlings may be had in profusion at a trifling cost.

PITCH PINE.

(See Plate 4).

(*Pinus rigida*).

A medium sized tree, common everywhere on rocky or sandy soil, and suitable for planting where many of the more attractive species refuse to grow.

It is a rugged pine, with rough, dark bark, and dark, green foliage, although not very handsome nor valuable for ornamental work. It is so much inferior to many other species of our native evergreens that it cannot be recommended highly for either parks or forests.

The wood is hard and very resinous, and consequently it causes a hot fire, but it is difficult to split, owing to the multitude of knots and branches.

PRICKLY PINE, TABLE MOUNTAIN PINE.

(*Pinus pungens*).

This species, which for many years was thought to be quite rare and restricted to almost one locality in North Carolina, is now known to be quite abundant in several districts of the Atlantic States, especially in Pennsylvania. The tree is of moderate size generally, although occasionally quite large, with pale bluish green leaves and large ovate cones bristling with hooked spines. These cones remain on for several years and impart a singular appearance to the tree. On account of its willingness to thrive on so many of the mountain ridges, it may prove to be a useful species to cultivate in similar situations; but the experiment has never been tried.

NORTHERN YELLOW PINE.

(*Pinus mitis*).

A very valuable species, usually found on dry, sandy land, and frequently attaining a large size. It has long, slender, deep green leaves, and when well-grown is by no means an unattractive tree. Although of slow growth, its hardiness and value for lumber are sufficient incentives to induce our foresters to pay more attention to its culture. The wood is fine grain, durable and not very resinous, supplying an excellent quality of timber for flooring and other purposes. As seen in most of its native localities, growing on barren hillsides or poor sandy tracts, there is nothing handsome about its appearance, and yet a solitary tree in rich, well drained soil is certainly a beautiful example of what an evergreen should be. As a rule all

pinus are more difficult to remove when a few feet in height than the generality of our other coniferous trees. This is owing to the fact that they are supplied with fewer rootlets than the spruces, abor-vitaes, hemlocks, junipers, etc., but frequent transplanting remedies this evil to a great extent. This rule, however, does not hold good with small seedlings.

NORWAY PINE, RED PINE.

(See Plates 36 and 37).

(*Pinus resinosa*).

If an incorrect name was ever applied to any of our arboresecent flora, "resinosa" is entitled to be classed in that record, as the wood is by no means so resinous as that of many other species. And the common name of Norway pine is equally incorrect, as it is one of our own native species, and a tree that we may well be very proud of. Growing from fifty to seventy-five or eighty feet high, with smooth, reddish bark and long, dark green leaves. it may surely rank with the finest of our cultivated conifers. As a timber tree, the wood of this species is compact, durable and strong, with the advantage of tall, straight stems. Although its cultivation may be somewhat delayed on account of the difficulty in procuring seed, still a sufficient quantity can be obtained to experiment with in suitable localities.

BLACK SPRUCE.

(*Picea nigra*).*

This is emphatically a mountain tree, but mostly confined to cold, wet situations, where it flourishes with considerable vigor. As an ornamental tree it is inferior to the white spruce (*picea alba*), but superior to that species for timber. It grows to the height of seventy or eighty feet, forming trunks eighteen to twenty-four inches in diameter, with tough, durable wood not very dissimilar to that of the white pine. The small ovate cones are very numerous, and at

*[See later in this volume, where the so-called black spruce has been divided into black and red spruce.—J. T. R.]

maturity their scales open and permit the seeds to escape. Consequently the latter must be collected as early as possible and kept dry until spring. In March, beds of light, sandy soil should be prepared and the seeds scattered thinly over the surface, to receive afterward a light covering of fine earth or sand. A protection of evergreen boughs must then be given them, raised a foot or more high to permit free passage of air over the surface, which acts as a guard against the attacks of fungi. The seedlings will appear in a short time, should the weather prove favorable, and nothing in the way of attention will be necessary for the first and second years, excepting to destroy all weeds. After that they may be "dibbled" into beds a few inches apart, to remain for two years longer, so that strength may be gained before the final removal to the proposed young forest.

HEMLOCK SPRUCE.

(See Plates 31 and 38).

(*Tsuga Canadensis*).

In the entire list of native conifers there are none that can exceed this in grace and beauty when properly grown. The long, drooping branches clothed with dark, green leaves, which are silvery below, the regular conical outline, and adaptability to most soils if not too dry, combine to make it one of the choicest specimens for the lawn. During its younger years it is wise occasionally to prune the outer branches, to induce a denser growth and more perfect form. The hemlock makes a charming ornamental hedge, bearing the shears with impunity, and soon becoming as dense as can be desired. Its value for timber is unquestioned, although inferior to the white pine and some others. The wood is coarse-grained and strong, but unsuitable for outside work where it comes in contact with the ground. On the other hand, it furnishes an excellent quality of cheap lumber for innumerable purposes, and the bark is highly prized for tanning. It may be propagated from seeds as heretofore described for the black spruce, but young plants are so numerous and cheap in its native localities, that one does not care to take the risk of raising seedlings.

These young plants taken from the forest and planted thickly in beds will, if carefully protected from the hot sun during the first year, by evergreen boughs, become well established in two seasons, and will then be suitable for setting in forest rows. It is advisable to cut off a portion of the top when removing from the woods.



(Plate 31. See pages 188 and 282.)

Typical, Mature Hemlock. Ganoga Lake, Sullivan County.





(Plate 32. See pages 182 and 259.)

Woodland Form of Chestnut Tree. Clearfield County.



AMERICAN LARCH.

(*Larix Americana*).

The European species is unquestionably a more valuable tree than this, both for ornament and timber, but as our native larch is eligible and useful in both ways, is easily obtained, and grows quickly into profit, we must not omit it from our list of remunerative species. It is a Northern tree and, of course, undeniably hardy, attaining a height of seventy-five feet, and even one hundred feet, with a straight trunk.

When cultivated, it forms a remarkably picturesque specimen, with slender, drooping branches, yet we occasionally notice a perfectly formed and regular outline similar to its near relative, the European larch. The leaves are linear and thread-like, with a handsome light bluish-green tint. This is one of our most difficult trees to transplant successfully when the operation is delayed too late in the spring, therefore some careful cultivators prefer doing the work in autumn, or else early in April before vegetation is active. They are very easily grown from seed in the same way as recommended for the preceding species, but the cheapest and, possibly, the best plan is to procure young seedlings a few inches high from their native haunts. If given protection in beds for one or two years, they will then be ready for removal to the permanent plantation, which may be in rows about four feet apart and the same distance in the rows. As the trees grow very rapidly, alternate plants may be cut in a few years, and disposed of for poles to be used in various ways.

AMERICAN ARBOR-VITAE.

(*Thuja occidentalis*).

Possibly there are more plants of this favorite evergreen disposed of in the nurseries of this country than of any other species. It is so easily grown and transplanted, so hardy, is so well adapted to all kinds of soils and situations, bears the shears with such impunity, and is so well suited to a variety of purposes, that we cannot wonder at its well-earned popularity. To use a common expression, it is emphatically the evergreen of the million. Although formal in its

manner of growth, a group of our arbor-vitae is especially pleasing, and a single specimen judiciously placed on the lawn is at all times an attractive object. As a hedge plant, however, it is without a peer, as nothing else can compete with it for cheapness, hardiness, durability, and fitness for the purpose. It is distinctively a tree of the North, attaining a height of fifty feet, with a trunk of twelve inches, or more, in diameter, and found growing mostly in low, wet situations. Notwithstanding it appears to prefer dampness, it flourishes equally as well on high, dry localities. The wood is very light, soft and durable, furnishing an excellent grade of fencing material, besides yielding a pungent aromatic oil when growing.

It may be raised with little difficulty from seeds sown thinly in beds and treated as previously explained, but as is the case with the last two or three evergreens, young seedlings are abundant in their native habitats, and grow after being transplanted with rarely any loss. Still, to guard against failure, it is best to give them the first year a shade of evergreen boughs. They might be set rather more thickly in the forest plantation than some other trees, where they rapidly arrive at a profitable age.

In conclusion it might not be amiss to mention two trees that have proven invaluable for covering the dry, barren wastes so prevalent in the western plains. Although it may strike the reader as a paradox to recommend trees that are here considered useless cumberers of the ground, still, it has been proven that no other arborescent forms of plant-life will thrive in absolutely dry soils with such vigor, and mature in so short a time as these, with possibly the exception of the box-elder, which has already been admitted into our descriptive list.

The absurdly named "tree of Heaven" or "tree of Paradise" (*Ailantus glandulosus*), is at the East a positive nuisance, not only on account of its pernicious habit of suckering so freely, but also on account of the nauseating and sickening odor of the sterile flowers. But its rapid growth, large size, clean, straight trunk and valuable timber are all worthy of consideration, especially when we know that it will grow where most other trees positively refuse to thrive. The timber is fine-grained, and takes a handsome polish, as well as being of use for fuel. Its propagation is of the easiest character, as the seeds, if preserved dry until spring, will germinate quite readily and form strong plants in a single season. The numerous suckers also afford a stock of young, embryo trees, and if the roots are cut into small pieces and sown thinly along the row, every little section will eventually form a new plant.

The other species to which allusion has been made in this paper, is "cottonwood" (*Populus monilifera*), which, although not so valuable for timber as the above, is worthy of consideration for very poor, sandy soils, where scarcely any vegetation will survive.

It delights in moisture, and yet will flourish in dry, barren localities, and on this account it may be used to good effect, even if the timber is not of special importance. It makes a large tree with a straight, round trunk and soft, light-colored wood, that is troublesome to split. There is such an abundance of suckers around old trees, that a fresh supply of young plants is readily obtained at all times. Cuttings of the young wood made in autumn, and set out at once, will grow with little trouble the following spring.

Having given general directions for the reproduction of our trees under their respective headings, perhaps it might be as well to permit them to suffice, but with a full knowledge of the great importance of the few vital principles governing the work, a slight resume of the more essential features may not be amiss.

In collecting all kinds of seeds, we must be constantly on the watch to prevent them from drying before committing them to the soil, or, if for spring planting, before placing in sand or other material for the winter months. The little embryo in all seeds is more or less affected by the absence of moisture, and should this condition be unduly protracted, germination will frequently be injured, if not entirely destroyed. Of course, there are exceptions to this rule, as, for instance, the seed of conifers, which, owing in a great measure to the amount of resinous matter contained in their cotyledons or seed-leaves, are generally secure from danger, for a year at least.

All seeds with a fleshy covering, like the magnollas, dogwoods, etc., must be washed free from the pulpy matter that surrounds them; and we mostly find such with extremely hard testas or bony shells, that require the action of frost to permit the germ to enter the soil. In the latter case, prudence suggests that they be planted early in autumn, else they may lie dormant in the ground for a year. Most nut-like seeds, as the chestnut, beech, walnut, shell-bark, etc., are exceedingly impatient of dryness, and the germs are almost certain to be destroyed if allowed to dry in the smallest degree before placing them in moist sand, or a similar substance. Owing to the fact that rapid evaporation commences to take place the moment they leave their natural covering, no seeds require such immediate attention after gathering as these, and it is useless to attempt their culture under different treatment.

One would naturally suppose that such hard-shelled seeds as walnuts and shell-barks possessed sufficient protection to the enclosed embryo, even after the fleshy "epicarp," or so-called hull was removed, but this is not the case. These nuts positively refuse to germinate if dried before committing to the soil, and yet, to all outward appearances, as well as to the taste, the inclosed seed is perfect. The peculiarities of the various species of acorns have been explained under their respective headings, but as the novice too often experiences considerable difficulty in their management, it is

well to reiterate here that while the black oak group is not so particular in regard to moisture, yet in certain seasons when humidity is unusually prevalent in the atmosphere, seeds of the white oak group will even germinate on the tree, and surely the moment they reach the moist earth. If acorns of all kinds are placed at once in moist, but not wet sand, and set away in a very cool, damp cellar, germination will be retarded, but not injured. The amount of moisture in sand for storing purposes, is a matter of no small importance. It is far better to use perfectly dry sand than to store seeds in it when very wet. The governing principle in seed germination has for its foundation, heat and moisture. Too much of either of these elements, or of both combined, will cause mold and decay, but a low temperature and a small amount of humidity arrests growth and holds it in a quiescent state. This fact is of the utmost importance in keeping all seeds. Seeds with hard or tough shells that have been kept dry over winter, must be soaked in hot water for from twenty-four to forty-eight hours before sowing in spring.

The question of the proper depth to sow seeds, is one of considerable moment, as too many ignorant people actually bury them, instead of furnishing a very slight covering of soil. Even in committing the largest seeds to the ground, such as walnuts, etc., one or two inches over them is preferable to five or six. The soil itself must be light and fine, and a due proportion of sand will be found useful with most species; and to preserve moisture, a slight covering of leaves or saw-dust admirably answers the purpose. A few small branches—evergreen preferred—scattered over the beds, tend to keep the soil moist and cool, assist germination, and are very helpful to the young plants in their earlier stages of growth. The cultivation of conifers from seed, is the most difficult operation the propagator has to accomplish, owing mainly to the difficulty in preventing the seedlings from “damping off.” But as the cause of this trouble, as well as the recognized preventives for its presence, have been fully discussed in the descriptions of this class of trees, it is useless to reiterate them here. While all large seeds may be sown in drills, say, two feet apart, and worked with a horse-cultivator, the small kinds should be sown in beds where they can obtain greater care. Beds that are from five to six feet in width can receive attention from either side, in the way of hand-weeding or hoeing, and the seeds should be sown in shallow drills across the bed, about twelve inches apart.

The practice of late years, of making the soil firm around newly planted seeds, as well as when planting trees, is of decided importance, so that a roller passed over the beds is a help not only to germination, but assists growth as well. In regard to the proper time for sowing seeds, in a general way, the earlier in spring after the soil becomes sufficiently dry, the better. Most species dislike a

hot soil to germinate in, and the young plants do not succeed as well as when the air is moderately cool and moist. Cuttings from such trees as root easily, made any time during the late autumn, are generally cut about nine inches long, tied in bundles and buried in trenches in an upright position.

At the earliest practical moment in spring, they should be set in furrows run out with a plow, sufficiently deep to permit the top bud to be a little above the surface. Ram the soil as firm as possible at the base of the cuttings, as in this lies the secret of success. They may then be treated in the same manner as seedlings.

The proper season for transplanting seedlings from beds to the proposed young forest, is not sufficiently appreciated by many inexperienced cultivators. The action of frost on soil during winter has a tendency to raise the seedling, so that not unfrequently we find them in spring lying on the surface of the beds. Protection with leaves during winter will obviate this by preserving a uniform temperature, thus affording protection against the disastrous effects of expansion and contraction in the ground. On account of the above, spring removal will be found more satisfactory, but the earlier the operation can be performed, the more certain will be the result. While autumn planting for most deciduous trees has its advantages, spring is decidedly better for all evergreens. The magnolias, and a few other trees, with soft, fleshy roots, should, however, never be disturbed until spring, and the operation with them may be delayed longer than with hard-wooded roots.

Cultivation in forest-rows is exceedingly simple, being precisely similar to that practiced by our nurserymen. Economy should be one of the objects always kept in view, although the term is distinct in its application from negligence. An ordinary horse-cultivator passed between the rows will usually keep down grass and weeds, as well as preserve an open, loose soil; but should weeds become troublesome in the rows, a small plow will be found useful in turning over a slight furrow against the trees, thus smothering out all objectionable vegetation. The same operation should be performed in late fall, but at that season a heavier furrow must be turned over, which affords an excellent protection to the trees and turns away from them a surplus of surface water. In the event of young trees showing the effect of impoverished soil, by the foliage turning yellow immaturely, or by small, tender twigs, it is proper to apply a top dressing of well-rotted manure, wood-ashes, bone-dust, etc., along the rows before plowing takes place.

Pruning is about the least important duty that one has to perform in forestry, for if the trees grow vigorously, the side-limbs will gradually die off as the shade increases from the mass of foliage; but still there are cases that require our aid in preserving an even, straight trunk, and there should be but a single leader to every tree

in the plantation. This may be obtained by an occasional examination in early summer, at which season all wounds from the use of the knife will quickly heal over and be secure before severe weather sets in.

If planted thickly, as all young forests should be, the need of thinning out will become apparent in a few years. This may not receive attention until the saplings are about two inches in diameter, when every alternate tree can be cut out and disposed of for numerous useful purposes at a profit.

JOSIAH HOOPES.

COLLECTING PINE SEEDS.

The strobiles, or cones, of the pine family proper require, usually, two years to mature, and frequently adhere to the tree for a considerable length of time thereafter. Indeed, in some instances, as in the case of the table mountain pine, they remain very often for several years, presenting a most novel appearance, as the clusters of cones mark distinctly many different stages of development. It is often the case that pine seeds are not sufficiently matured in autumn for gathering, and in fact so long as the scales of the cones do not open and liberate the contents, the collector need be in no haste to secure the crop. It is reasonable to suppose that nature affords a protection that cannot well be improved upon, and if the seeds be permitted to remain in their cones until spring, even if removed from the tree in autumn or mid-winter, the chances are that a larger percentage of young plants will result.

Pine seeds generally contain a large amount of oil, and this is liable to become rancid and injure the germ, especially if the seeds are kept in a moist atmosphere.

Although the cones of some species of pines open readily at maturity, as, for instance, those of the various members of the white pine group (i. e., those species having five leaves in a sheath), others including those of the table mountain and red pines, remain closed for a long time, and require a certain amount of drying to assist the scales in opening so that the seeds may fall out. Fire-heat is occasionally resorted to by experts to accomplish this result, but it should never be practiced by the unskilled propagator, as a very high temperature is almost sure to injure vegetation. There is not so much danger in adopting the method employed by some European collectors, of immersing the cones in warm water until the scales are

softened so that they will more readily open during the drying process. Even this plan, however, should not be followed, except in extreme cases, as all artificial assistance is fraught with more or less risk to vitality. The most advisable plan is to spread the cones out in the sun until thoroughly dry, when the scales will gradually uncloze and liberate the seeds, which can then be stored away in a dry room until needed for planting.

In collecting seeds of the spruce (*Picea*) and fir (*Abies*), little difficulty is experienced, owing to the fact that as soon as ripe the seeds are liberated and fall to the ground. In the case of the former, the scales spread out at maturity, thus permitting the seeds to drop out. When the cones of the latter are fully ripe, scales and seeds fall simultaneously, the axis or stem remaining on the tree for some time longer. The cones of both genera should be closely watched and collected as soon as the opening scales indicate the ripening season to be at hand. If spread out thinly in a warm dry room, or even in the sun for a short time, the seeds may be shaken out, placed in paper bags and kept in a dry temperature until the planting season. The cones of the larch are not always mature in autumn, but when permitted to remain on the tree until spring, the scales usually open and the ripe seeds drop out. At any rate, if dried for a short time, the scales will open and if gently shaken the seeds will be liberated.

JOSIAH HOOPES.

CHAPTER XII.

CATALOGUE OF THE FOREST TREES OF PENNSYLVANIA
HAVING COMMERCIAL VALUE.

This report is not intended as an exponent of advanced scientific ideas. It is prepared at the expense of the people of the State, by order of the Legislature, and therefore should be made in the language most readily understood by the largest number of intelligent citizens. Hence, the author makes no apology for discarding every technical term he can, and for using (when he must) those recognized by the largest number. He is conscious in this course of no wrong to any respectable interest in the Commonwealth; nor is he in any way ignoring or undervaluing the importance of exact scientific terminology. On the contrary, he desires expressly to say, that in his judgment, it is well worth the cost to the State to prepare scientific manuals in every branch of natural history for liberal distribution to the people. In the case of this list, however, nothing of accuracy is sacrificed in making a report which will in the plainest possible language tell the practical relations of our forest trees to the people. Interests quite too large and vital are at stake to risk any limitation because of unintelligible language. It will therefore be understood that the accepted popular name of a tree is placed first, and that the scientific name that follows is the one found in Gray's Manual of Botany; this being the most complete and reliable text book in reach of the public generally; though to give facility of reference to the most complete work on our American Silva, text and plates for each species in Sargent's Silva of North America, are indicated, so far as that is completed.

SWEET BAY, SWAMP SASSAFRAS, BEAVER TREE.

(*Magnolia glauca*, L.). (Sargent, Silva N. A., Vol. I, p. 5, t. 3).

Tree ten to forty-five feet high, sap wood almost white, heart wood reddish-brown, light, soft and weak. Bark smooth, whitish or light brown. Leaves three to six inches long, tapering to a stalk about one-fourth their length, narrowly oblong in shape, margin not toothed, under surface, grayish-green, deeper green above; flowers

white, two to three inches across, very fragrant, appearing in June. Flowers matured in October; fruit green, cone-like, an inch or more in length, seeds scarlet, often hanging by delicate threads from the opened cone.

This tree is of no great value, nor is it very common in Pennsylvania. The bark of the young stems and of the root is fragrant and has been used in domestic medicine as a tonic in the milder forms of fevers. In some places the cones are soaked in liquor and the resulting liquid used as a remedy in diseases of malarial origin. It might also be added that it is used as a preventive of chills. The sweet bay prefers damp, or even swamp soils. Owing to the tendency of the seeds to decay, it is necessary to keep them in a cool, damp place until spring. It is said that the tree may be propagated from layers, which require two years to root. The physical properties of the wood, as stated by Sargent and Sharpless, are specific gravity, 0.5035; percentage of ash, 0.47; relative approximate fuel value, 0.5011; weight in pounds of cubic foot (dry), 31.38; relative strength, 170. The tree has a slight value in cabinet work and house furnishing. It is worthy of a place in every yard as an ornamental tree, where there is a moist spot in which to plant it.*

CUCUMBER TREE, MOUNTAIN MAGNOLIA.

(*Magnolia acuminata*, L.). (Sargent, *Silva N. A.*, Vol. I, p. 7, t. 4, 5).

Tree sixty to eighty or more feet high, trunk eighteen inches to three feet in diameter, bark light gray, on old trees moderately fissured, wood light (heart wood darker), durable, capable of taking a fine polish, leaves thin, somewhat hairy beneath, five to seven inches long, oval, more or less pointed, margin entire, footstalk one to two inches long. Blooms in June, flowers bell-shaped, when fully open four to six inches across, bluish-green or somewhat cream-colored fragrance very faint. Fruit in October, green, cylindrical, two or three inches long, seeds much as in the sweet bay. (Name "cucumber tree" comes from faint resemblance of fruit to small cucumber.) The liquor in which the cones have been soaked has been used as a preventive of malarial chills.

This tree, no where abundant in Pennsylvania, is most frequently found in the valleys of the most mountainous portions of the State. It is quite often found along the rocky streams of Mifflin county. No where can it be said to form a forest, or, so far as I have ob-

* The physical properties, as given in these descriptions, are all quoted from the authorities above named.

served in the State, even to give a character to a forest. Indeed the tree is not recognized by the larger part of the population; which fact will serve still farther to point the remarks already made concerning its rarity. The cucumber tree is of beautiful, symmetrical figure and of commanding size. It is, however, open, and often, even in healthy trees, lacks that degree of density in foliage essential to a perfect shade tree.

Economically, the cucumber tree is of considerable importance. It probably has no rival in the market for pump logs. It is used also for water troughs. It makes too soft a flooring to last well; but owing to its light color, capacity for taking polish, and its lustre, makes a good wood for cabinet work, especially when the natural color is preserved. The physical properties of the wood are stated by the authors already quoted, thus, specific gravity, 0.4690; percentage of ash, 0.29; relative approximate fuel value, 0.4676; weight in pounds of a cubic foot of dry wood, 29.23; relative strength, 208. In the Southern states there is another species (*Magnolia cordata*, Michx.) which is also called cucumber tree.

UMBRELLA TREE, ELK WOOD.

(*Magnolia Umbrella*, Lamarck). (Sargent, Silva N. A., Vol. I, *Magnolia tripetala*, p. 13, t. 9, 10).

Tree twenty-five to forty feet high, three to six inches in diameter, bark smooth and gray, and said by Michaux to be ill-odored if cut while green. Wood of almost no commercial value, that of heart brown, that of sap almost white, leaves one to two feet long, and six to eight inches wide, thin, pointed, tapering into a footstalk, margin not toothed. Flowers in May. Flowers white, six to eight inches across, odor slight, but hardly pleasant. Fruit cone-like, red, three to six inches long, and two inches in diameter. Seeds reddish, becoming rancid so soon that they must either be planted at once or kept in a cool, damp place until wanted for planting. The umbrella tree is rare in the southeastern part of Pennsylvania. It prefers low, rich grounds. It is hardy, and conspicuous from the umbrella-like clusters of great leaves on the ends of the branches, and hence worth a place among the ornamental trees; but it is of almost no other value. Physical properties are, specific gravity, 0.4487; percentage of ash, 0.20; relative approximate fuel value, 0.4478; weight of cubic foot of dry wood, 27.96 pounds; relative strength, 250.

TULIP TREE, TULIP POPLAR, YELLOW POPLAR.

(*Liriodendron Tulipifera*, L.). (Sargent, *Silva N. A.*, Vol. I, p. 19, t. 13, 14).

Tree eighty to one hundred and twenty feet high, diameter (in Pennsylvania) five and a half feet occasionally. Bark light in color, deeply furrowed; sap wood light colored, heart wood yellow. It is well known that there are two varieties of this species of tree; one of which produces a white wood, the other a lemon yellow wood. Accordingly they are known among our lumbermen as white and yellow poplar. It seems to be simply a case of the relative abundance of the sap and heart wood, and not a real specific difference in the trees. The white poplar has usually a more branching top, and it is said to grow on higher and more gravelly soils. The external differences in the two varieties are so slight and variable that I have thus far failed to predict the color of the log before the tree was cut, nor have I been able to discover any person who could always distinguish them in advance. Leaves as broad as, or broader than long, with two conspicuous lateral lobes and one double central lobe, three to six inches long, thin, light green in summer, turning yellow in autumn. Flowers conspicuous, appearing in May, tulip-like, greenish-yellow, with a tawny, orange centre within. Fruit cone-like, composed of numerous scales each an inch or more long, and one-sixth as wide.

The tulip poplar is beyond doubt the grandest tree of our Pennsylvania forests, so far as size and appearance go. It loves a rich, damp, but not too moist soil, and is more or less commonly found throughout Pennsylvania, being perhaps less common in the more mountainous parts than in the lower lying regions.

Economically the tulip poplar is among the most valuable trees. By many practical lumbermen it is regarded as the coming substitute for white pine. Though it once grew abundantly, to an enormous size in the fertile southwest, it has become so scarce and difficult of access, that the prices are distinctly on the advance. An objectionable feature of the wood is its tendency to swell and shrink with atmospheric changes. Seasoning does not wholly correct this tendency, if the wood is used in any place where there are changes of temperature or of moisture in the air. It has been largely used in cabinet work, in making carriage boxes, pump stocks and in interior finish, weather-boarding, shingles and dug-out canoes. The bark of the root contains a stimulating tonic principle which has long been recognized, though but little used in medicine.

The tree requires considerable care in raising. In the first place it does not take kindly to removals, unless its roots have been well

bunched by frequent transplanting in the nursery, then again pruning is said not to agree with it (though my own observation does not confirm this statement). Then, too, the seeds are not to be found in all the cone scales, or even in all the cones. Careful observation will enable one both to recognize the fertile seeds and how rare they are. The physical properties are, specific gravity, 0.4230; percentage of ash, 0.23; relative approximate fuel value, 0.4220; weight of cubic foot of dry wood, 26.36 pounds; relative strength, 213.

PAPAW.

(*Asimina triloba*, Dunal). (Sargent, *Silva N. A.*, Vol. I, p. 23, t. 15, 16).

Small tree ten to twenty feet high, with a diameter of six to eight inches. Bark smooth, light gray; wood light, weak and of no special use so far as known. Leaves five to nine inches long and one-fourth as wide, pointed, tapering to the short footstalk, margin entire. Purple flowers appearing with or before the leaves, one inch and a half across. Fruit matured in September, two to five inches long, green, pulpy, containing several large seeds; edible, for boys.

This tree is more properly a member of the Southern woods, although it grows in rich ground along some of our rocky water courses. In Mifflin county it occasionally becomes quite large. Its physical properties are stated thus, specific gravity, 0.3969; percentage of ash, 0.21; relative approximate fuel value, 0.3961; weight of cubic foot of dry wood, 24.73 pounds; relative strength, 302.

BASS WOOD, AMERICAN LINDEN, LIME TREE, LIN.

(*Tilia Americana*, L.). (Sargent, *Silva N. A.*, Vol. I, p. 52, t. 24, 25).

Tree sixty to eighty feet high and from two to three feet in diameter when mature, bark (outside) light gray, moderately fissured when old. Inner bark tough, capable of being made into mats and cordage. Heart and sap wood white or brownish or reddish-brown in color. Leaves usually unequally heart-shaped, three to six inches

long, nearly smooth, thickish, margin sharply toothed. Footstalk about half as long as the leaves. Blooms in July, flowers cream-colored, fragrant, three-fourths of an inch across, from ten to thirty (flowers) terminating a slender stalk attached to the lower half of which there is a narrow ribbon-like leaf. The one-seeded fruit, hard, round, hairy, gray and as large as a pea, matured in September.

The American linden, though not so symmetrical as the European linden, is nevertheless a tree of striking beauty. One seldom sees a tree of this kind in any position where it does not by itself, or in association with its surroundings, form a picture. It might almost be called the artist's tree. Its favorite location is a damp hillside, or on the banks of some stream, none the less suitable if it should happen to be rocky. All in all, there are but few trees that are more generally useful than the linden. It is neither first-class as a lumber, or as fuel, but it subserves many purposes; thus, cabinet and carriage makers find it of great value. So, too, do turners and stair-makers. Its wood makes a good quality of charcoal, for special purposes, for example, the manufacture of gun-powder. No tree is more sought when in bloom by the bees than the American linden; hence in some parts it is commonly called the bee tree. The wood is used also in the manufacture of paper pulp. The physical properties of the wood are thus stated, specific gravity, 0.4525; percentage of ash, 0.55; relative approximate fuel value, 0.4500; weight in pounds of a cubic foot of dry wood, 28.20; relative strength, 249.

WHITE BASS WOOD, WAHOO.

(*Tilia heterophylla*, Vent.). (Sargent, *Silva N. A.*, Vol. I, p. 57, t. 27).

Tree much like the above, except that it is smaller, has large leaves which are covered on the under surface with a fine, silky down. This species extends no farther north than Pennsylvania, whereas the linden reaches into the British provinces. The white bass wood is used for much the same purposes as the linden.

AMERICAN HOLLY.

(*Ilex opaca*, Ait.). (Sargent, Silva N. A., Vol. I, p. 107, t. 45).

Tree with us not exceeding forty feet in height, and eighteen inches in diameter; bark whitish or light gray; sap wood almost white; heart wood inclining to brown, after exposure. Leaves oval to oblong, spiny toothed, evergreen, thick. Flowers small, whitish or inclining to yellow, in clusters, seated just above the insertion of the leaves. Berries a quarter of an inch in diameter, red, remaining all winter on the tree.

Wood is close-grained, but hardly strong. It works readily and as it polishes well, and is of a cheerful light color, it is in demand for furniture, and interior finish, as well as for turners' work. It is quite abundant in New Jersey, but by no means so in Pennsylvania. As an ornamental tree it deserves a place on the lawn. The seeds are said to be slow in germinating, requiring, unless forced, two or even three years before sprouting. It is also said that autumn cuttings from the summer shoots "placed in sandy soil in a shady border and covered with hand glasses will put forth roots in the following spring."

The physical properties of the wood are, specific gravity, 0.5818; percentage of ash, 0.76; relative approximate fuel value, 0.5774; weight of a cubic foot of dry wood, 36.26 pounds; relative strength, 195.

OHIO BUCKEYE, FETID BUCKEYE.

(*Aesculus glabra*, Willd.). (Sargent, Silva N. A., Vol. II, p. 55, t. 67, 68).

Small tree from twenty-five to forty-five feet high; bark smoothish, light colored; wood light, soft, often crooked-grained; that of the heart white and of the sap something darker; leaves on a footstalk two to four inches long; leaf composed of five leaflets each of which is oval, sharp pointed and minutely toothed on the margin. Flowers in a compact mass, several inches long, yellowish, stamens protruding from the flower by half their length. Fruit covered with prickles, when young, and resembling that of the horse chestnut.

This tree is often seen as an ornament about homes, though

less frequently so than its foreign relative, the horse chestnut. It is a fairly rapid grower and produces a wood which though light and weak is still very valuable in the manufacture of "wooden ware, artificial limbs, paper pulp, wooden hats," bearings of shaftings and occasionally lumber. This species is readily produced from seed. The bark contains a principle sometimes used as a substitute for Peruvian bark in malarial troubles.

The physical properties of the wood are, specific gravity, 0.4542; percentage of ash, 0.86; relative approximate fuel value, 0.4503, weight in pounds of a cubic foot of dry wood, 28.31; relative strength, 279.

SWEET BUCKEYE.

(*Aesculus flava*, Ait.). (Sargent, *Silva N. A.*, *Aesculus octandra*, Vol. II, p. 59, t. 69, 70).

A somewhat larger tree than the preceding one, from which it differs in having larger, yellow flowers, stamens not protruding from the flower; smooth, instead of prickly fruit, and larger leaves. Its uses are essentially the same as those of the Ohio buckeye; grows readily from seed. Is not common in Pennsylvania. Physical properties are, specific gravity, 0.4274; percentage of ash, 1.00; relative approximate fuel value, 0.4231; weight in pounds of a cubic foot of dry wood, 26.64; relative strength (?).

STRIPED MAPLE.

(*Acer Pennsylvanicum*, L.). (Sargent, *Silva N. A.*, Vol. II, p. 85, t. 84, 85).

Small tree, seldom over thirty feet in height and four inches in diameter; bark is greenish or often brown with a tinge of yellow, usually with darker stripes; hence the common name "striped maple." Wood light-colored, not very strong, but having, when polished, more or less of a pearly lustre. Leaves very slightly heart-shaped at base, three to six inches across, strongly three-lobed, each

lobe having as a rule a long tapering point, margin of leaves usually sharply double-toothed; footstalk of leaf about half as long as the leaf is wide. Flowers in June, greenish, in long drooping clusters from a central stem. Fruit matures in September or October, with broad, diverging, veiny wings. Commonly found in cold ravines among the mountains of Pennsylvania, though it ranges from the Saint Lawrence Valley south along the mountains to Georgia. It is rather rare as a real tree in Pennsylvania. Commercially it has but little value. In Maine it is most frequently called "moose wood," as it furnishes a favorite browsing for these animals and also for the domestic animals that are hard pressed for forage in the late winter and early spring months. F. Andre Michaux asserts, plausibly enough, that at this season these tender shoots contain enough saccharine matter to make them more palatable and nutritious than might at first sight appear. The wood is said to have a very limited use in cabinet making. The physical properties of the wood are, specific gravity, 0.5299; percentage of ash, 0.36; relative approximate fuel value, 0.5280; weight in pounds of a cubic foot of dry wood, 33.02; relative strength (?).

SUGAR MAPLE.

(*Acer saccharinum*, Wang.). (Sargent, Silva N. A., *Acer barbatum*, Vol. II, p. 97, t. 90, 91, 92).

One of the largest trees, possibly also the commonest one, within the limits of the State. It ranges in height from seventy to one hundred feet, and in diameter from two to five feet, according to the soil and location. Bark even in very old trees, but moderately roughened, not greatly inclined to shell; except in colder parts of the State, where it sometimes almost resembles a shell-bark hickory, light gray in color, and usually much covered with the smaller crustaceous lichens. Heart wood light brown, sap wood nearly white. Leaves moderately heart-shaped at base, somewhat broader than long, distinctly three or five-lobed, the angle between the lobes usually rounded, and the lobes themselves deeply toothed; footstalk of the leaf about half as long as the leaf; flowers with no (flower leaves proper) petals, drooping from the end of the young shoots or coming from the side, and each with a distinct stalk of its own. Fruit matured in September, wings an inch long, and half as wide, moderately diverging. For the variety of uses to which this wood can be put it is probably

surpassed by no other in our State. It is among the very best and hardest, and at the same time most beautiful of our native trees. This especially adapts it to the purposes of the landscape gardener. It grows with a moderate rapidity, and seems not wholly to refuse to grow on any soil. We find it crowning the tops of the highlands of the State, and at the same time flourishing in the lowland meadows. Its leaves, in autumn, changing from green to crimson, scarlet, or gold, are the crown of our landscape, and furnish by their mass and richness a coloring which is probably unequalled in the forest of any other part of the globe. The shape of the tree as a rule is symmetrical. It lacks the sweeping grace of the elm, but more than compensates for this by giving us the robust strength of the oak. Of all our trees none is easier to propagate. Indeed, the tendency is for the seeds, after having laid all winter under the leaves, to come up in the spring as weeds. Considering the wood from the standpoint of the artisan the sugar maple would require a volume to bring out its merits. Thus, Professor Sargent writes of it, "Wood heavy, hard, strong, tough, close-grained, compact, susceptible of a good polish, largely used in the manufacture of furniture, shoe lasts and pegs, saddle trees, in turnery for interior finish and flooring, in ship-building for keels, keelsons, shoes, etc., and furnishing valuable fuel; 'curled' maple and 'birdseye' maple, accidental forms in which the grain is beautifully curled and contorted, are common and highly prized in cabinet-making."

"The ashes of this wood, rich in alkali, yield large quantities of potash." For the value of the sugar maple in the production of sugar, and also for the best methods of manufacturing, see the report of Mr. Sisson, also article from "American Agriculturist," both in Chapter VIII of this volume.

It is alleged that the variety of poplar so common in North Carolina, and known there as "birds-eye" is produced as the result of the injury done to the cambium (young wood and bark) layer by wood peckers hunting for the larvae of insects. If this be true, it is more than likely that the same cause would explain the production of the birds-eye maple.

The physical properties are, specific gravity, 0.6912; percentage of ash, 0.54; relative approximate fuel value, 0.6875; weight in pounds of a cubic foot of dry wood, 43.08; relative strength, 21.

BLACK SUGAR MAPLE.

(*Acer saccharinum*, Wang, var. *nigrum*, T. & G.).

This, the black variety of sugar maple, is distinguished from the type described above, mainly, by the lobes of the leaves being shorter, wider and entire; also by the bark being much darker. The leaves are also thicker, and hence darker because more opaque. The tree produces the same sweet sap as the typical sugar maple, and is associated with it also in growth, and therefore likely to be overlooked. It differs considerably, however, in its physical properties, thus, its specific gravity is, 0.6915; percentage of ash, 0.71; relative approximate fuel value, 0.6866; weight in pounds of a cubic foot of dry wood, 43.08; relative strength, 71, as against 21, which was the relative strength of the genuine sugar maple. (It appears probable that further investigation will raise the relative strength of this wood).

SILVER, WHITE OR SOFT MAPLE.

(See Plate 29).

(*Acer dasycarpum*, Ehrh.). (Sargent, *Silva N. A.*, *Acer saccharinum*, Vol. II, p. 103, t. 93).

Tree from sixty to ninety feet high, and with a diameter, in this State, of from one to four feet; bark light gray in color, rather smoother in adult trees than that of the sugar maple. Wood soft when green, harder when dry; only fairly strong, white, close-grained, easy to work, but not durable. Leaves on footstalks as long as themselves, i. e., five to six inches, and almost as wide, deeply diverging into three or five lobes, which are again more or less three-lobed and sharply cut-toothed; under surface of leaves silvery white; young leaves brownish hairy; flowers from side buds, in clusters of fives or sevens, greenish, without flower leaves proper (petals); fruit when mature in May, with wings, two or three inches long, quite veiny. (In the young state the fruit is downy).

In its utilities the soft or silver maple is in every way inferior to the sugar maple. It is true that it does produce a certain quantity of sweet sap which may be utilized in the production of sugar, just as is that of the sugar maple, but it is very seldom used for this purpose. As a shade tree it is no less inferior except where rapid growth is the only element to be considered. It develops very rapidly into a large size and has also a fine shape, but the wood is so

soft and weak that it is unable to support its own great bulk. Then, too, every open place in the trunk, whether made by the ax or the wind, affords an opening for the attacks of fungal foes, which is speedily taken advantage of. Hence the tree is short-lived, and is in premature decay often when it should be in its prime. It is frequently recognized in cheap furniture and in flooring. The tree may be easily produced from seed planted immediately after it is matured; but the probability is that we shall always have enough of it by spontaneous growth, unless it should be in larger demand than now for pulp, excelsior or other like purposes.

The physical properties are, specific gravity, 0.5269; percentage of ash, 0.33; relative approximate fuel value, 0.5252; weight in pounds of a cubic foot of dry wood, 32.84; relative strength, 56. Standing, thus, about midway in strength between the typical sugar maple and its black variety. The silver maple flourishes best in the colder parts of the State.

RED MAPLE, SWAMP MAPLE.

(*Acer rubrum*, L.). (Sargent, *Silva N. A.*, Vol. II, p. 107, t. 94, 95).

A much smaller tree than the above, attaining with us a height of about sixty feet, although it may occasionally reach eighty feet; in diameter it seldom exceeds two feet, in Pennsylvania. Bark is somewhat smoother and darker than that of either the soft or sugar maple. Wood whitish, or with a reddish tinge. Leaves two to four inches long, on footstalks one to five inches long, under surface lighter colored than upper, three-lobed and sometimes five-lobed, sharply toothed, but less deeply so than in the silver maple. Flowers appear among the very earliest in the spring, bright scarlet, or sometimes tawny in color, in clusters, from the side buds of the young branches, each flower on a thread-like footstalk of from one-fourth to three-fourths of an inch long. Fruit matured in September, on a thread-like footstalk, bright red in color, with diverging wings, each of which is three-fourths of an inch to an inch in length.

This species of tree is one of wide range, from New Brunswick to Florida. It attains its greatest size and beauty in the swamp lands to the south and west of us. In both spring and fall it is one of the most conspicuous features on the landscape. Before even the willow twigs have commenced to look green or yellow, the swamp maple lends its bright colored flowers to beautify the banks of our streams.

In the autumn it is even more rich in the coloring of its leaves than the sugar maple, and if it were as abundant a tree, it would by all odds be a more striking character in the country. The wood has the elasticity but not the durability of the ash. It polishes well and readily lends itself to the purposes of the turner. In fact, much of the better class of furniture half a century ago was made of the red maple. The rifle stocks of earlier days, on which so much time and labor were bestowed by the local gunsmith and the subsequent owner, were of curly maple, which is a form of the red maple and in which the fibres were markedly contorted and serpentine in their direction. The red maple furnishes other patterns (of fibre) to which special names are given and they may even imitate the lustre of silk. As a shade tree the red maple is desirable, where it will thrive, but it will not endure the dry situations as well as some other trees. The buttonwood, although it usually selects ground as wet as that chosen by the red maple, will thrive on a much drier soil. So, too, will the swamp white oak.

The physical properties of the swamp maple may be thus stated, specific gravity, 0.6178; percentage of ash, 0.37; relative approximate fuel value, 0.6155; weight in pounds of a cubic foot of dry wood, 38.50; relative strength, 126. It is therefore the weakest of the maples thus far considered.

BOX ELDER, ASH-LEAVED MAPLE.

(*Negundo aceroides*, Moench.). (Sargent, Silva N. A., *Acer Negundo*, Vol. II, p. 111, t. 96, 97).

A small, much-branched tree, with brownish, rather smooth bark, seldom thirty feet in height in this State, or attaining a greater diameter than one foot. Wood nearly white or with a slightly yellowish tinge, weak; leaves composed of three or five ovate, irregularly bluntly-toothed leaflets; petiole (leaf footstalk) three or four inches long. Flowers yellowish green, appearing from side buds on the young branchlets, in April, male and female flowers on different trees. Fruit matured in September, in clusters more or less drooping from slender threads which are about an inch long, wings of fruit not widely spreading, less than an inch long, greenish and quite veiny in the matured specimen.

This tree cannot be said to be very common in Pennsylvania. It has no special value here, and hence its scarcity is no misfortune in

a region where more valuable trees will grow and are needed. The tree is widely different in those western regions where but few trees can be made to thrive. Its merits in that section were tersely summed up in the remark, "It is enough better than nothing."

The physical properties of the box elder are, specific gravity, 0.4328; percentage of ash, 1.07; relative approximate fuel value, 0.4282; weight in pounds of a cubic foot of dry wood, 26.97; relative strength, 270.

STAGHORN SUMACH.

(*Rhus typhina*, L.). (Sargent, *Silva N. A.*, Vol. III, p. 15, t. 102, 103).

A small tree or large shrub; bark smooth or very slightly roughened, grayish brown; seldom more than thirty feet high, and from six to twelve inches in diameter, wood pale yellow, streaked with pale green, that of the sap lighter colored; young branches very hairy. Leaves compound, one to two feet long; leaflets eleven to thirty-one in number, each lance-shaped, sharp pointed, toothed and on under surface lighter-colored. Flowers appear in June and form a dense yellowish-green mass on the ends of the young branches. Fruit matures in September, forming a compact mass of reddish-brown, hairy, sour, seed-like bodies, which are occasionally placed in hot water to make a gargle that is much in favor as a domestic remedy for sore throat. This little tree grows to best advantage along the sides of damp, rocky hills. It is, however, capable of enduring quite dry situations. The smaller hollow trunks (an inch in diameter) are, or were before tin tubes were found to be a more desirable substitute, employed to conduct maple sap from the tree to the receptacle, pail or trough. It is worthy of note that no American wood makes a more beautiful panel, and the fact that it is rarely found of large size would not in the least diminish the value of the larger specimens when once the qualities of the wood were recognized. It should also raise the question, whether or not the tree when found thriving on waste land is not worthy of protection. Besides the wood, the leaves and bark contain tannin enough to give them a value in the manufacture of leather. A dye is also present in them. We can quite concur with an observing lady who suggests that the staghorn sumach is well worthy of a place in our lawns as an ornament, when autumn brings its rich coloring to the leaves. Her idea was to hide the straggling character of the individual shrubs by

massing them. It should be added that the male and female flowers are more or less separated, the clusters being individually, male or female in character. It is also worthy of note that despite the general dread of sumach, no poisonous species of this group in our State has a (matured) red fruit; the noxious having a fruit which (when mature) is smoothish and whitish or yellowish-white in color.

The physical properties of the staghorn sumach are thus given by Professor Sargent, specific gravity, 0.4357; percentage of ash, 0.50; relative approximate fuel value, 0.4335; weight in pounds of a cubic foot of dry wood, 27.15; relative strength (figures not in Sargent's tables, but it is not very great).

No other species of this group in Pennsylvania is worth considering in this connection.

LOCUST TREE, BLACK LOCUST, YELLOW LOCUST. .

(*Robinia Pseudacacia*, L.). (Sargent, Silva N. A., Vol. III, p. 39, t. 112, 113).

A most valuable tree, native to the mountainous parts of Pennsylvania, and attaining there a height of sixty feet, or according to Darlington, of eighty feet. It occasionally becomes something more than two feet in diameter. The young branches are thorny, the bark is conspicuously furrowed, dark gray or brown in color externally, and internally of a reddish hue. It yields to the knife a gritty "feel" when being cut, which is due probably to the abundance of minute crystals the bark contains. The innermost fibrous bark has a yellow color. Wood strong, durable and of rapid growth, with the further very great advantage that the yellow sap wood is very early converted into matured, brown, heart wood. Leaves compound, a foot or more long, made up of from three to nine pairs of elliptical blunt-pointed leaflets, which are entire on the margin and from one to two inches long. Flowers white or cream-colored, fragrant, in drooping clusters from the axils of the leaves, appearing in May. Fruit a pod from two to four inches long, maturing its seeds in September.

The locust tree is indigenous along the mountains from Georgia to Northern Pennsylvania, and when the wood is solid, is one of the best and most durable of all our timbers. The "locust borer" however, has made such severe ravages on the trees, that in spite of the desirability of the wood and the rapid growth and tendency to multiplication by shoots, it is fairly a question as to whether its general cultivation can be recommended. There are localities in this State,

and especially among the mountains, where it still appears to be reasonably free from the borer; nor do I think the depredations are as severe as formerly; but nevertheless the cultivation of the locust should be undertaken with the fact in mind that a foe is in sight. The locust was once very largely grown in Europe where it had been introduced among the earliest trees taken from this country. It appears to have lost some of its popularity. Under the name of "acacia" it was very common along the French and German boundary. The durability of the wood is wonderful. I recently removed a post from the ground where it had been in a most exposed place for about forty years. There was hardly a sign of decay perceptible. As a treenail for supplementing the nails or bolts by which ship planking is fastened to the timbers, the locust certainly has no rival among our native woods. For "timbers" of small vessels it is unsurpassed. It is also occasionally used in making the hubs of very heavy wagons. It must be remembered that with strength and durability the locust combines ease of working. An individual may during his lifetime see no less than three generations of locust raised from the same roots to a size sufficiently large for most of the purposes to which this wood is usually applied. Besides the ease with which it is produced from sprouts rising from the ground around the base of the stumps, it is no less easily raised from cuttings large or small. No other native tree, unless it be the various species of willow, can surpass it in this respect. To reproduce it from the seed, these must, or at least should be, soaked in hot water before planting sufficiently long to soften the outer coat. Their prompt germination may then be expected. The bark of the wood is said to be tonic in small doses and emetic and cathartic in larger ones.

The physical properties of the locust are, specific gravity, 0.7333; percentage of ash, 0.51; relative approximate fuel value, 0.7296; weight in pounds of a cubic foot of dry wood, 45.70; relative strength, 3. It will thus be seen that in strength it heads the list of our native Pennsylvania trees.

JUDAS TREE, RED BUD.

(*Cercis Canadensis*, L.). (Sargent, *Silva N. A.*, Vol. III, p. 95, t. 133, 134).

A small tree from fifteen to thirty feet high and seldom with a diameter of a foot; bark moderately roughened in small somewhat oblong flakes, brown or reddish in color; wood dark brown, that of

the sap lighter, hard and heavy, but not strong, taking a very good polish. Leaves heart-shaped, three to four inches long, and on foot-stalks from one to two inches in length. Flowers in clusters along the branches, red or purple and appearing in April before the leaves. The lower leaves of the flowers are united into a canoe-like body; fruit a brownish pod, maturing in June.

This tree is conspicuous in early spring from the bright color and abundance of its flowers. If more symmetrical it would be a welcome addition to our list of ornamental trees. While it grows on soil of almost any character, it seems, with us, to prefer the sides of limestone ridges, and on some of our stream banks is abundant enough to color them red. The wood thus far has not been specially utilized, although one might have supposed it would have been.

The physical properties are, specific gravity, 0.6363; percentage of ash, 0.72; relative approximate fuel value, 0.6317; weight in pounds of a cubic foot of dry wood, 39.65; relative strength, 173.

KENTUCKY COFFEE TREE, COFFEE NUT.

(*Gymnocladus Canadensis*, Lamarck). (Sargent, Silva N. A., *Gymnocladus dioica*, Vol. III, p. 69, t. 123, 124).

Tree from sixty to ninety feet high and from one to two feet in diameter. When destitute of leaves it has a remarkably "clubby" appearance from the absence of small branchlets; bark dark brown, closely fissured, in general aspects much resembling the walnut, the wood reddish brown, that of the sap lighter color. But for its durability the wood seems to have little to recommend it. It is heavy without being strong, and although it takes a good polish, it is nevertheless coarse grained. Leaves compound, made up of several primary divisions, and these bearing each from seven to thirteen ovate, sharp-pointed leaflets on stalks that are not more than one-eighth of an inch long. Flowers, male and female separated (each on distinct trees) appearing in May from the axils of the leaves, white, or greenish white, in clusters that are three to six inches long. Fruit, a pod several inches long (6 to 8), and from one to two wide; somewhat curved like a sickle. Matures in October.

The Kentucky coffee tree is by no means common in Pennsylvania. If native here at all, it is on the southern or southwestern border. It is sometimes known here as mahogany and *lignum vitae*. In cultivation it is by no means rare, and may fairly claim a notice as ornamental on the lawns; but in the arts it seems to have but little place.

Its physical properties are, specific gravity, 0.6934; percentage of ash 0.67; relative approximate fuel value, 0.6888; weight in pounds of a cubic foot of dry wood, 43.21; relative strength, 149. Strength is wholly below what might have been anticipated from the weight. The name coffee tree is misleading. No one seems to have persisted in using any part of it as a substitute for coffee.

HONEY-LOCUST.

(*Gleditschia triacanthos*, L.). (Sargent, *Silva N. A.*, Vol. III, p. 75, t. 125, 126).

A fine tree from fifty to eighty feet high, and sometimes from two to three feet in diameter.

Bark is smooth, not usually much roughened even on the old trees; with stout thorns which are often three-parted, or occasionally even more branched.

Wood, a clear, reddish-brown color, that of the sap lighter in color. Quality is first rate, being strong, durable and capable of receiving a good polish. Its color, moreover, is in its favor.

Leaves, compound, i. e. of small leaflets on the primary or secondary branches of the common leaf-stalk. Leaflets elliptical, blunt-pointed, and slightly, if at all, toothed.

Flowers in July, in close, somewhat elongated clusters, of a greenish color and inconspicuous.

Fruit, a pod with from one to many seeds, and so thin that it often curls. The seeds are bedded in a soft pulp, which is sweet while still fresh, and in that condition is used to produce a domestic beer by fermentation, but later this pulp is said to become very sour.

The honey-locust is frequently seen with us as a shade tree in our fields. It is however, sometimes a source of danger to domestic animals, the sharp, hard thorns puncturing the tender parts of the feet. It is almost certain that the future will lead to larger utilities for this tree. Michaux tersely sums up its merits by the statement that it is never used by the carpenter or wheelwright, and only by the farmer when he could get nothing better. Professor Sargent, writing much later, thinks the wood worthy of a higher esteem than we have yet given it. The honey-locust seems to have reached the Juniata Valley from the regions to the west of the mountains. I have been much interested in watching its gradual spread from the upper to the lower waters of the river during the past forty years—apparently by the current.

Physical properties are, specific gravity, 0.6740; percentage of ash, 0.80; approximate fuel value, 0.6688; weight in pounds of a cubic foot of dry wood, 42.00; relative strength, 81.

WILD CHERRY, WILD BLACK CHERRY.

(*Prunus serotina*, Ehrh.). (Sargent, Silva N. A., Vol. IV, p. 45, t. 159).

This tree, ranging over a large part of the State, varies greatly according to the position where it is found. It was once very abundant in the wooded, northern portion of the State, but has become one of the rarest of our large trees. In the woods it attains a great height, rising frequently to ninety feet, and reaching a diameter of two and a half feet. On the other hand, when, as it now is most frequently found, it is in the open country, it branches from the base, spreading as it rises, into a form but little more than half so high, but much broader through the branches. In other words, it strikingly illustrates the difference between the woodland and the open ground form of a tree.

Bark varying from light gray to dark brown in color, according to age. It tends to separate in flakes of an elongated, rectangular outline more than that of most other trees. The bark of the wild cherry, by its fracture, conveys the idea of brittleness.

Wood of the heart a dull, light red, which matures into a deeper, richer tint after long exposure to light and air. Sap wood yellowish.

Leaves, lance-shaped, thickish, pointed; margins with fine, incurved callus-pointed teeth.

Flowers, white, in clusters from two to four inches long, on the end of the branches of the previous year, blooming in May.

Fruit matured in August, dark purple, or black, about a quarter of an inch in diameter, of which the bitter pulp is the smaller and the stone the larger part.

The wild black cherry, though not of the greatest real utility, deserves to rank high among our native species, because of its value in cabinet work and in interior finish. The black birch is often substituted for it in the market.

Wild cherry bark has long figured in medicine and probably as well deserves its place as any other "home remedy." The bitter principle in the bark when brought into contact with cold water acts as a mild sedative, from the hydrocyanic acid produced. The bark enjoys also a reputation as a tonic. Its real value in that direction is, I think, not proven.

The wild cherry is a tree of fairly rapid growth and worth a place as an ornamental tree, or even as a tree which after having furnished shade during the earlier part of its life, might in full adult condition become a source of revenue for the lumber which it would produce.

Physical properties, specific gravity, 0.5822; percentage of ash, 0.15; relative approximate fuel value, 0.5813; weight in pounds of a cubic foot of dry wood, 36.28; relative strength, 119. Wood, light, strong and takes a good polish.

FIRE CHERRY, PIGEON CHERRY.

(*Prunus Pennsylvanica*, L. fil.). (Sargent, Silva N. A., Vol. IV, p. 35, t. 156).

Differs from the above mainly in being a smaller tree, having its flowers in small clusters from the sides of the branches, and in blooming before, or about the time the leaves appear, while the wild black cherry leaves are well out before the blossoms come.

It has no value whatever, so far as I am informed. The name "fire cherry," it has received from its tendency to appear on ground cleared of trees, and then burned over; when this tree immediately takes possession of the soil, often to the exclusion of everything else. It may thus be regarded as a valuable nurse plant for some more valuable tree.

AMERICAN CRAB-APPLE.

(*Pyrus coronaria*, L.). (Sargent, Silva N. A., Vol. IV, p. 71, t. 167, 168).

Tree from ten to twenty feet high, and seldom over a foot in diameter. Bark, much resembling that of the ordinary apple tree in its color and fracture. Heartwood, brown or red, that of the sap wood yellow. The wood, if larger might be of real importance. Though not strong, it is heavy and close-grained, taking a good polish and being well adapted to the purposes of the turner. To prevent cracking or checking as it dries, it requires very slow seasoning. Leaves, simple, broadly ovate, somewhat heart-shaped at base.

Flowers, very fragrant, red, or slightly so, in clusters on the end of the short, spur-like branches, appearing in May.

Fruit, from an inch, to an inch and a half in diameter, very sour and somewhat astringent in taste, and of but little use except to make into cider and preserves. It is yellowish-green in color and very fragrant. The wood has small place in the arts, but is sometimes used for making tool handles, wedges, etc. The American crab-apple tree is not unworthy a place on our lawns, and by judicious care may be made attractive. The delicious fragrance of its flowers is a real recompense for a rather rugged form.

Physical properties are, specific gravity, 0.7048; percentage of ash, 0.52; relative approximate fuel value, 0.7011; weight in pounds of a cubic foot of dry wood, 43.92; relative strength, 282. Strength much below what might be expected from weight of the wood.

MOUNTAIN ASH.

(*Pyrus Americana*, DC.). (Sargent, Silva N. A., Vol. IV, p. 79, t. 171, 172).

A small tree, native of the cooler parts of the United States and reaching south into the higher regions of this State. It seldom attains a height greater than thirty feet, or a diameter of more than one foot. Young bark bright green, becoming darker with age. Branches few, making, ordinarily, a sharp angle with stem.

Wood of the heart brown, and of the sap almost white, and of no special value in the arts.

Leaves, compound, of from eleven to fifteen leaflets which are lance-shaped, usually sharp-pointed with teeth toward the point, and clustered on the ends of the branches. Flowers appear in June, and are small, white and clustered.

Fruit, a berry, red or orange-colored, in clusters, which in autumn form the most striking feature of the tree, and one that adds much to its value as an ornament. The tree has no value in construction.

Its physical properties are, specific gravity, 0.5451; percentage of ash, 0.83; relative approximate fuel value, 0.5406; weight in pounds of a cubic foot of dry wood, 33.97; relative strength—no figures, but strength is not great.

COCKSPUR THORN.

(*Crataegus Crus-galli*, L.). (Sargent, Silva N. A., Vol. IV, p. 91, t. 178).

A large shrub, or small tree much branched, and abundantly armed with sharp, strong thorns, which are often from two to three inches long. Bark, dark; fractures small. Wood, hard, heavy, lacking in strength, polishes well; that of the heart reddish brown, sap wood of lighter color. Leaves, thick, glossy, broadly ovate, and doubly toothed, especially toward the blunt point, tapering into a short footstalk. There is a manifest tendency for the leaves and white flowers to cluster on the ends of the short thick branches. Blooms in June. Fruit, more than a quarter of an inch in diameter, reddish brown, matured in October.

Generally speaking, it cannot be claimed that the cockspur thorn fills any very important place in our economies. It is, a fair hedge plant, but probably not as good as the osage orange, and it is very doubtful whether since the introduction of wire fence, either of them is of great importance now for that purpose. Its wood doubtless might be of use in the manufacture of turned wares.

Physical properties, specific gravity, 0.7194; percentage of ash, 0.56; relative approximate fuel value, 0.7164; weight in pounds of a cubic foot of dry wood, 44.83; relative strength, 218.

JUNE BERRY, SHAD BUSH.

(*Amelanchier Canadensis*, T. & G.). (Sargent, Silva N. A., Vol. IV, p. 127, t. 194, 195).

A small, variable tree, seldom more than thirty feet high in this State, or more than a foot in diameter; much oftener a mere shrub, which runs into several more or less well defined forms.

Bark, in the older specimens, light gray from the lichens which adhere to it; on the younger specimens it is of a reddish hue.

Wood of the heart reddish brown, that of the sap whiter, heavy, strong, because of its close grain, polishes well; hard when dry, but liable to split in drying.

Leaves (of typical form) two to three inches long, about half as broad, somewhat heart-shaped at base, and on footstalks, from half an inch to an inch in length, sharp-pointed, margins with smallish teeth sharp and irregular in size.

Flowers, white, appearing in April, before the leaves, quite showy.

In bloom about the time the shad are running in the Delaware river, and hence one of the common names of the tree in Pennsylvania.

Fruit, a quarter of an inch or more in diameter, dark purple when fully matured and edible then. The fruit is generally known in the northwestern region under the name of service berries, and is largely used, being, in fact, the most desirable fruit of the country for cooking, or for mixing with the pemmican (while being made) as an antiscorbutic.

If size be taken as a guide, we may assume that the June berry tree is essentially a tree of the north, which has degenerated in its present southern range. However, large specimens even in Pennsylvania are not wanting wholly. One was noted in Monroe county that had a diameter of about eighteen inches, and seemed to be in perfect vigor. I have also noted others almost as large. The wood is serviceable for a number of things, and has been suggested as a substitute for box wood in the hands of the engraver.

Physical properties, specific gravity, 0.7838; percentage of ash, 0.55; relative approximate fuel value, 0.7795; weight in pounds of a cubic foot of dry wood, 48.85; relative strength, 26; hence the shad bush must be ranked among the strongest woods.

GUM, SWEET-GUM, BILSTED.

(*Liquidambar Styraciflua*, L.). (Sargent, *Silva N. A.*, Vol. V, p. 10, t. 199).

One of the largest trees of the southern United States. As it is somewhat out of its range in this State, it seldom exceeds eighty feet in height and from two to two and a half in diameter. Ordinarily it is very much smaller with us. Wood of the heart, brown or red; that of the sap, white, hard, heavy, elastic, polishes beautifully.

Leaves on long footstalks, with five large lobes (two lower lobes smaller) radiating in a more or less star-like manner.

Flowers, male and female in different clusters, or heads, on the same tree.

Mature fruit, a ball an inch in diameter roughened by projecting beaks between which are openings into the seed cavities.

From the size and abundance of this tree in the south, it should be a very important wood there, and hence of value to us here when imported as lumber. The chief trouble has been in its tendency to

warp when drying. It is said, however, that this may be obviated by cutting the bark off from around the trunk, girdling and killing the tree, allowing it to stand a year and become seasoned before felling it. If this is so, there will undoubtedly open up new possibilities for it in the market. The sweet-gum is by no means common in Pennsylvania, being mainly confined to the eastern part, along the Delaware river and regions adjacent. It does not appear to be used for anything here, though the demand for it is undoubtedly increasing elsewhere. As a wood for interior finishing of houses it is being more appreciated in the eastern cities. It is sometimes used as a substitute for black walnut, and it is also used "for veneering and for street pavements."

Physical properties are, specific gravity, 0.5909; percentage of ash, 0.61; relative approximate fuel value, 0.5873; weight in pounds of a cubic foot of dry wood, 36.82; relative strength, 222. Wood is much weaker than we should expect from its weight.

A gum is produced by this tree that is occasionally used for catarrhal troubles, and the inner bark boiled in milk was in repute in the south as a remedy for diarrhoea.

DOGWOOD. FLOWERING DOGWOOD, BOXWOOD.

(*Cornus florida*, L.). (Sargent, *Silva* N. A., Vol. V, p. 66, t. 212, 213).

It should be stated here that the first name, dogwood, is practically the only one used within the limits of Pennsylvania for this tree.

Tree, from fifteen to thirty feet high, and having a diameter of about one foot as a maximum.

Wood, brown, or reddish brown, hard, heavy, strong, polishes well, but cracks in seasoning.

Bark, brown or gray, rather scaly, with markings of small, more or less rectangular, pattern.

Leaves, three to five inches long, opposite each other; when young, silky or downy; when mature, less hairy; lance-shaped to ovate, margin slightly wavy, or toothed, or almost entire; base, sometimes though seldom, heart-shaped; turning a dull red in autumn.

Flowers, in May, greenish-yellow, in a small compact cluster inclosed in a larger white, or red and white, flower-like involucre, which is from two to four inches across. This involucre commonly called the flower, is conspicuous and beautiful, often giving color to the whole tree, as the leaves do not appear until after the flower.

Fruit in September, red, with thin pulp over central stone, eagerly eaten, after having been frosted, by the winter birds. It is fair to remark, as Emersor has already done, that the tree is almost as showy in autumn from the bright red, scarlet or orange berries as it is in spring with the conspicuous involucre.

The dogwood is worthy of general use as an ornamental tree. For the arts, in a small way, it possesses many very valuable properties. For example, it has been used to a limited degree as a substitute for boxwood, and among our native kinds of wood, few take a more beautiful polish than the dogwood. It is also used in the manufacture of tool handles, and of cogs, where hard usage is anticipated, and is occasionally used for hubs in wheels. The young stems, or shoots, when straight, are said to make good hoops for coopering purposes. In addition, dogwood has no mean standing as a remedy. It is true that the preparations of cinchona have in a great measure superseded it. This, however, is not because the dogwood is lacking in value, but because the cinchona is pre-eminently valuable. It may be justly said that dogwood bark is a good tonic, and is valuable in the treatment of intermittent fever. Emerson writes that "from the bark of the smaller roots the Indians obtained a good scarlet color, and the smaller branches, stripped of the thin bark and used as a brush, are said to render the teeth extremely white."

The dogwood is a tree of wide geographical range, growing from New England to Florida and from Ontario to Texas. Toward its most southwestern limit, it becomes a much larger tree than it does in Pennsylvania; further north it is reduced in size to a mere shrub.

The physical properties of dogwood are, specific gravity, 0.8153; percentage of ash, 0.67; relative approximate fuel value, 0.8098; weight in pounds of a cubic foot of dry wood, 50.81; relative strength, 91.

ALTERNATE-LEAVED DOGWOOD, DOGWOOD.

(*Cornus alternifolia*, L.). (Sargent, *Silva N. A.*, Vol. V, p. 71, t. 216).

For this small tree no common name appears to exist in Pennsylvania. Following Darlington, I have simply translated its ordinary botanical name. Dogwood as given by Professor Sargent is never, so far as I know, used as a name for this tree in this State.

Small tree, or large shrub, seldom exceeding twenty-five feet in height here, and having a trunk of not more than four inches in diameter. Trunk, greenish or grayish-green; slender curving branches of same color, but streaked with white, oblong bodies.

Flowers, small and appearing in May, with four thread-like stamens protruding from the throat of the flowers, the latter arranged more or less in flat-topped clusters on the ends of the young branches.

Leaves, oval, margins entire, more or less taper-pointed, two to three inches long, upper surface darker green than the lower; footstalks of leaves slender, an inch or more in length.

Fruit, ripe in autumn, dark blue or almost black, with a seed or stone; footstalk red.

This little tree does not seem to have any known value either in mechanical art, or in medicine. It may merit a place on our lawn where a full collection of native plants is desired, but aside from this it offers no special attraction.

Physical properties, specific gravity, 0.6696; percentage of ash, 0.41; relative approximate fuel value, 0.6669; weight in pounds of a cubic foot of dry wood, 41.73; relative strength, not given.

TUPELO, PEPPERIDGE, BLACK OR SOUR GUM.

(*Nyssa sylvatica*, Marsh.). (Sargent, Silva N. A., Vol V, p. 75, t. 217, 218).

Tree from forty to seventy feet high, and seldom more than two feet in diameter; variable in form, but always with a rugged aspect; bark, dark, deeply cleft into oblong or square masses; wood, fairly strong, difficult to split owing to the twisting and interlacing of fibres; that of sap and heart both almost white; leaves rather thick, smooth, lance-shaped or broadly oval, margins not notched or toothed, tapering at each end, but as a rule rather broader at tip than base; footstalks half an inch to an inch long.

Flowers having sexes separated and on different trees, or one tree having flowers with both sexes, and another having flowers of but one sex. Flowers small, greenish and inconspicuous, either single or in clusters from above the footstalks of the leaves. Blooms in May. Fruit matured in September, almost half an inch long, the solitary seed, a stone somewhat triangular and longitudinally marked.

The black gum, as this tree is most frequently called here, is a species with marked individuality, and may be picked out at a distance by the decided and abrupt curves or rather angular curves of its branches. It seems to differ more than most trees in the angle at which these leave the main stem, and also in the shape of the top, which may be either broad, indeed, almost square, or in other in-

stances quite tapering and almost spire like. There is also a distinct sheen, or glisten, on the thick leaves in early summer, and a brilliant red, or even scarlet in autumn. Its mature fruit attracts the robins and flickers in great numbers, and hunters acquainted with this fact often haunt a fruit-laden gum tree where the victims fall an easy prey to inconsiderate sportsmen, so-called. The wood, though quite durable when protected against atmospheric changes, readily decays if exposed to alternate conditions of wet and dry. For example, it makes a fairly good keel to a large vessel which is supposed to remain in the water, but on the other hand is poorly fitted for the same office in a smaller vessel which is frequently left out of water for considerable periods.

There are certain purposes for which the wood of the gum tree is especially well fitted. The extreme difficulty, not to say impossibility, of splitting it has long made the gum a favorite with the rural wheelwrights as a hub material. Of late years it has, to a very great degree, been superseded for this purpose by the wood of the rock elm. It also (the gum) does duty for rollers in glass factories, for ox yokes, hatters' blocks and, as asserted by Professor Sargent, as a pile for wharves in the gulf region. It was once in great demand in Central Pennsylvania for the manufacture of hominy blocks, and also, when hollow, as a rude bee hive.

The tupelo, or gum tree, extends from Maine to Michigan, and from Florida to Texas. It usually flourishes best in a damp or wet soil, though this is by no means essential to its growth.

Physical properties, specific gravity, 0.6356; percentage of ash, 0.52; relative approximate fuel value, 0.6323; weight in pounds of a cubic foot of dry wood, 39.61; relative strength, 118.

SORREL TREE, SOUR WOOD.

(*Oxydendrum arboreum*, DC.). (Sargent, Silva N. A., Vol. V, p. 135, t. 235).

This little tree is not common within our limits. It sometimes attains a height of forty feet. The wood is hard and heavy, close-grained and susceptible of a beautiful polish. Leaves from two to five inches long and a fourth as wide, pointed at end, toothed on margin and with a short footstalk. Flowers appear in June in long clusters on the ends of the young branches, white, one-fourth of an inch long, tubular or somewhat contracted toward the open end. In

fruit the seed vessel is recurved on the delicate footstalk which is about a quarter of an inch long. Does not grow north of south-western Pennsylvania, but extends thence southward, usually along the mountains, almost to the Gulf of Mexico. . I know but little of it personally, but it is said to have a limited usefulness in "making tool handles and bearings for machinery."

The physical properties are, specific gravity, 0.7458; percentage of ash, 0.37; relative approximate fuel value, 0.7430; weight in pounds of a cubic foot of dry wood, 46.48; relative strength, 172.

LAUREL, MOUNTAIN LAUREL, CALICO-BUSH.

(*Kalmia latifolia*, L.). (Sargent, Silva N. A., Vol. V, p. 139, t. 236, 237).

Ordinarily a shrub of but a few feet high, though sometimes attaining, even in Pennsylvania, almost tree proportions. As for example, on North Mountain, in Sullivan county; and in the Southern Alleghenies it becomes forty-five feet high and nearly two feet in diameter. Leaves, evergreen, thick and smooth, lance-shaped, two to three inches long, on footstalks about one-fourth of an inch long. Flowers, appear in May in great red, or white clusters, on the end of the branches, more or less viscid or sticky, as also are the thread-like footstalks on which they are borne; stamens at first bent back into little pockets in the depth of the flowers, then released and converging around the style. Fruit mature in September, a rounded dry seed-vessel, containing many minute seeds.

The compact, hard wood has long been used in a small way for making tobacco pipes, and is also in repute for tool handles. Owing to the crooked nature of the stems they lend themselves readily to the work of making rustic chairs, boxes, etc. The leaves of the laurel are a reputed poison to cattle, but I am not aware that this allegation has been proved, or disapproved. It should, however, be positively settled. So far as I have been able to observe, I have seen no facts that pointed to poisoning more than to excessive gorging on the part of the suffering cattle.

The laurel forms dense thickets in parts of our mountains, where along the streams it is sometimes associated with the large rose-bay or Rhododendron. The laurel thrives well also on some of our driest ridges. It is in the mountains of the Southern States that the laurel forms the most impenetrable jungles. The name, calico bush, seems to refer to the variegated appearance which the masses of the flowers present alone or in combination with the dark, green leaves. The thickets of laurel and rose-bay are a favorite hiding place for the black bears.

The physical properties are, specific gravity, 0.7160; percentage of ash, 0.41; relative approximate fuel value, 0.7131; weight in pounds of a cubic foot of dry wood, 44.62; relative strength, 227.

RHODODENDRON, ROSE-BAY, GREAT LAUREL.

(See Plate 40).

(*Rhododendron maximum*, L.). (Sargent, Silva N. A., Vol. V, p. 149, t. 238, 239).

Shrub or small tree from ten to thirty-five feet high. In general aspect so like the common laurel that it often receives the name of mountain laurel. Compact wood, light brown, hard, heavy and strong up to a certain point, then giving way suddenly with a snap that is very suggestive of brittleness. Leaves, five to seven inches long, evergreen, thick, smooth and glistening, broadly lance-shaped, rather blunt pointed, tapering toward the base, margin somewhat rolled back, especially in very cold weather. Flowers, an inch to two inches across, white or rose color, "greenish in the throat," and often spotted inside "yellowish or reddish," in fine compact, large, head-like clusters. Fruit elongated, dry, hard and many seeded. No product of our colder mountain gorges can compare in beauty with the *Rhododendron*. When in bloom in June or July it attracts all beholders. It extends south along the Alleghenies and attains its greatest luxuriance of size and of flower in the mountains of North Carolina.

It has been suggested that the wood might furnish a substitute for "box" in engraving. Tool handles and canes have been made from the stems. Apart from its beauty its uses at present are unimportant.

The physical properties are, specific gravity, 0.6303; percentage of ash, 0.36; relative approximate fuel value, 0.6280; weight in pounds of a cubic foot of dry wood, 39.28; relative strength, 213.

PERSIMMON.

(*Diospyros Virginiana*, L.). (Sargent, *Silva N. A.*, Vol. VI, p. 7, t. 252, 253).

A middle sized tree with dark bark deeply cleft into surfaces of square or oblong shape. Wood, of the heart brown to black, that of the sap somewhat lighter in color, heavy and hard, polishes well. Leaves, two to three inches long, rather thick, ovate or oblong, smooth, somewhat veiny, rather sharp pointed, margin not toothed, footstalks of leaf about half an inch long. Both sexes in the same flower, or separated and on different trees. Flower yellowish, appearing in June. Fruit, about an inch in diameter, four to eight-seeded, reddish or orange colored, very astringent until thoroughly ripe and frosted, then sweet and rather pleasant to the taste. The persimmon tree is essentially a Southern species, although it does occasionally reach as far north as Connecticut and Iowa. In Pennsylvania it is common along the southern border and in the eastern part of the State. Persimmon culture has become in certain portions of the West quite common. The prospect is that before long there will be many improved varieties of the fruit in the market. The Japan persimmon has long been known and prized as a fruit. Few people, however, have as yet recognized what seems to be now established, i. e., the great possibilities from systematic and judicious cultivation of our own native species. The wood of the persimmon is in many respects unique. Its capacity for enduring friction is phenomenal. Hence its value for journals and cogs. It is well appreciated also by turners. In very old trees the heart wood becomes almost black. The fruit is occasionally used in this State "when fermented with hops, corn meal or wheat bran" to produce "simmon beer." The green fruit and the inner bark are used in domestic medicine for their astringency, in cases of sore throat and diarrhoea. Porcher, speaking for the South, says the unripe juice of the fruit may be used for tanning, and that a black dye may also be obtained from it. The "mature fruit yields on distillation, after fermentation, a quantity of spirits, and (the fruit) mixed with flour makes a pleasant bread."

The physical properties are, specific gravity, 0.7908; percentage of ash, 0.96; relative approximate fuel value, 0.7832; weight in pounds of a cubic foot of dry wood, 49.28; relative strength, 102.

WHITE ASH.

(*Fraxinus Americana*, L.). (Sargent, Silva N. A., Vol. VI, p. 43, t. 268, 269).

One of our largest and most important trees, attaining in Pennsylvania a height occasionally of eighty, or in rare instances of ninety feet, with a diameter of from three to five feet. One example was known in Chester county where the trunk was almost six feet in diameter at three feet above the ground. Bark, light gray, furrowed to a moderate depth into oblong divisions, of a somewhat regular size, say, from four to six inches long and an inch wide. Wood, of sap light colored, that of heart brown or reddish brown. Leaves, compound, made up of from seven to nine leaflets; each of which is from three to five inches long, oblong in outline, somewhat toothed and rather sharp pointed; under surface a little hairy, and somewhat lighter in color than the upper. Flowers, male on one tree and female on another, small. Males in dense brown clusters, and females in lighter-colored, looser clusters, both kinds, however, formed just above leaf marks of previous year. Fruit, from an inch to an inch and a half long, less than a fourth of an inch wide, blunt pointed or occasionally slightly notched at the apex, the longer, winged part tapering down gradually into the darker seed portion, which varies between a fourth and a half an inch in length.

Probably no tree varies more in the quality of its wood than this species of ash. Indeed, in the same tree trunk the physical properties of the wood may, and do, differ widely. The chief use to which ash is put is in the manufacture of oars, and every one who has had experience in purchase, or use, of these knows how they vary in quality, some being capable of long use, retaining their strength and elasticity to the very last, and others snapping on the first application of a severe strain. Nor can their difference be said to be wholly due to the direction of the grain of the wood. In cases where the length of the oar is practically wholly in the direction of the grain, one oar may be strong and elastic and another positively brittle.

I cannot refrain from quoting at second hand what Evelyn long ago said of one other species of ash, but which applies with equal force to our own species. "It serves the soldier and heretofore the scholar, who made use of the inner bark to write on before the invention of paper. The carpenter, wheelwright and cartwright for plows, axletrees, wheelrings, harrows, bulls, it makes good oars, blocks for pullies and sheffs (shieves), as seamen name them. For drying herrings no wood is like it, and the bark is good for the tanning of nets; and like the elm, for the same property (of not being so apt to split

and scale) is excellent for tenons and mortices; also for the cooper, turner and thatcher; nothing is like it for our garden palisade-hedges, hop-yards, poles and spars, handles and stocks for tools, spade-trees, etc. In sum, the husbandman cannot be without the ash for his carts, ladders and other tackling, from the pike to the plow, spear and bow, for of the ash were they formerly made and therefore reckoned among those woods which, after a long tension, has a natural spring and recovers its position; so as in peace and war it is a wood in highest request. In short so useful and profitable is this tree, next to the oak, that every prudent lord of a manor should employ one acre of ground with ash to every twenty acres of other land, since in as many years it would be worth more than the land itself."* The above quaint quotation seems most fully to illustrate the importance of the ash to the yeoman of centuries back. It may well be added that though the direction of its utilities has been somewhat changed, it can hardly be said they have been appreciably diminished by modern life. Add to the above uses, that it is in great demand for cabinet work and interior finish, and that the otherwise useless parts of the trunk make good fuel and it will be seen that in the American ash we have a tree of the greatest economic value.

Physical properties, specific gravity, 0.6543; percentage of ash, 0.42; relative approximate fuel value, 0.6516; weight in pounds of a cubic foot of dry wood, 40.78; relative strength, 110.

RED ASH.

(*Fraxinus pubescens*, Lam.). (Sargent, *Silva N. A.*, *Fraxinus Pennsylvanica*, Vol. VI, p. 49, t. 271).

Tree seldom exceeding sixty feet high and two feet in diameter. It so resembles the white ash that unless closely examined it may readily be mistaken for it. It probably shows more tendency to branch than the latter, the bark, however, is much like that of the white ash. The wood is decidedly inferior to that of the latter, though one would hardly infer so by comparison of the physical properties. The fact, however, is determined and may well enough be accepted. The under surface of the leaflets of the red ash, and the leaf foot-stalks, as well also as the young branches, are hairy, whereas those of the white ash are quite, or wholly smooth. The wing of the fruit

* Quoted from Emerson's Report on the Trees and Shrubs of Massachusetts 1846, p. 333.

of the red ash is much like that of the white ash, but the seed end of the fruit in the latter is somewhat thickened, whereas in the red ash the seed end is much more slender and tapers out gradually into the footstalk.

The red ash has much the same geographical range as the white ash, in fact the two are seen often closely associated in the same place. It may be said that the red ash has about the same general range of usefulness that the white ash has, but in an inferior degree. It can be used for the same purposes, but is not quite as good.

Physical properties, specific gravity, 0.6251; percentage of ash, 0.26; relative approximate fuel value, 0.6235; weight in pounds of a cubic foot of dry wood, 38.96; relative strength, 105. It will be seen that while the red ash is lighter than the white ash, it is above the latter in strength, but still ranks lower for general purposes as a lumber.

GREEN ASH.

(*Fraxinus viridis*, Michx., f.). (Sargent, Silva N. A., Vol. VI, *Fraxinus Pennsylvanica*, Var. *lanceolata*, p. 50, t. 272).

Is a smaller tree than either the white or the red ash described above. Its leaflets are bright green on either upper or lower surface, are inclined to taper toward either end, and are toothed more or less plainly toward the apex. Seeds, from an inch and a half to two inches long and less than a fourth of an inch wide; seed base almost an inch long, very slender and tapering imperceptibly into the slender, thread-like footstalk. Wood, inferior to that of the white ash, but often used when the other is not available.

Physical properties, specific gravity, 0.7117; percentage of ash, 0.65; relative approximate fuel value, 0.7071; weight in pounds of a cubic foot of dry wood, 44.35; relative strength, 95.

BLACK ASH, HOOP ASH.

(*Fraxinus sambucifolia*, Lam.). (Sargent, *Silva N. A.*, Vol. VI, *Fraxinus nigra*, p. 37, t. 264, 265).

Tree sometimes fifty feet high and said by Emerson to be the most slender of the ash group, reaching, he says, in Massachusetts a height of seventy to eighty feet, but with a diameter of not more than a foot. The bark differs from that of the ash species already described in being darker, less furrowed and having the "epidermis applied in broad sheets." Wood, of heart dark brown, of sap lighter, sometimes nearly white. Leaflets tapering toward apex, with very short, or no, footstalks, margin distinctly toothed. Fruit, a fourth of an inch or more broad. Seed end short, thick and with a narrow margin of wing extending clear down to footstalk. The buds of this ash are dark blue, or black and the young shoots a yellowish gray "with lighter dots." The wood of the black ash is very tough, and has long been used in manufacture of baskets. To obtain the material in suitable form, long strips are taken, of suitable width, then beaten with mallets on the side toward the bark. This ruptures the thinner-walled spring tissue and so liberates the thin layers of hard wood out of which the baskets are woven. Used also in interior finish, for hoops and to a certain extent in cabinet making.

The tree grows as far north as the Gulf of Saint Lawrence and south to Virginia. With us it is usually found in wet grounds. "The bruised leaves emit the odor of elder leaves," and this may aid in recognizing the tree.

Physical properties. specific gravity, 0.6318; percentage of ash, 0.72; relative approximate fuel value, 0.6273; weight in pounds of a cubic foot of dry wood, 39.37; relative strength, 131.

FRINGE TREE. OLD MAN'S BEARD.

(*Chionanthus Virginica*, L.). (Sargent, *Silva N. A.*, Vol. VI, p. 60, t. 277, 278).

A small tree or shrub, seldom exceeding thirty feet in height and six to eight inches in diameter. Bark, rather smooth, light gray. Wood, of the heart light brown, that of the sap almost white. Leaves, two to five inches long, thin, smooth, or somewhat hairy on

the veins, oblong, tapering into short footstalks, margins without teeth. Flowers, in large, loose clusters, appearing in June, each flower of four white, ribbon-like parts and tending to be arranged in threes, on slender footstalks. Mature stone fruit of a blue-black color and about half an inch in length. The value of the root bark, when used in decoction, has been authoritatively recognized in fevers of malarial origin and in weak conditions of the system.

Physical properties, specific gravity, 0.6372; percentage of ash, 0.51; relative approximate fuel value, 0.6340; weight in pounds of a cubic foot of dry wood, 39.71. Of no importance as a lumber, but common in cultivation as an ornamental tree. Grows from our southern border to the Gulf of Mexico.

CATALPA, BEAN TREE, INDIAN BEAN, CIGAR TREE.

(*Catalpa bignonioides*. Walter). (Sargent, Silva N. A., Vol VI. *Catalpa Catalpa*, p. 86, t. 288, 289).

This low, much branching, quick-growing tree has been introduced to our State from the region of the Gulf of Mexico. It has, however, become so thoroughly naturalized that one may regard it as fully established. Bark, light brown, slightly cleft into elongated shapes, distinctly fibrous in its inner layers. Wood, is light and soft, but very durable. Flowers, white, somewhat purple-tinged, having purple and yellow spots inside, an inch and a half long, tubular and with an irregular, two-lipped opening. When blooming in June the large compact masses of flowers make this among the most showy of our trees. Leaves, from four to seven inches wide, on footstalks, heart-shaped at base, taper pointed, margin not toothed. Fruit pod matured in October, black or dark brown, from five inches to a foot long and almost half an inch thick, packed with flat, winged seeds.

There are certain qualities which this tree possesses and which confer upon it a wide range of usefulness. It grows quickly, and will flourish on almost any kind of soil without regard to quality and whether it is wet or dry. I have now in mind places where on the one hand, it is growing with its roots in a flowing stream, and on the other it is thriving upon the dry side of a railroad embankment. Furthermore, it may be grown with equal facility from seeds, shoots, or bits of roots. In fact, it will take care of itself under almost any conditions. As we usually see the tree, its trunk is short and completely dwarfed by the heavy branches and the mass of luxuriant

foliage. But to obtain a longer, straight trunk, which in some sense represents a log, it is only necessary to allow your young shoot to be firmly rooted, first, then cut it back to the ground and induce a vigorous shoot to spring up which may be kept pruned for a year or two, or better still, plant the trees in close masses. By thus sending the whole strength into one leading shoot a good stick of timber may be readily obtained. The wood is known to be durable and if properly matured there seems to be no reason why it should not make good posts. It would have unquestioned value in holding exposed banks against destructive washes.

Physical properties, specific gravity, 0.4474; percentage of ash, 0.38; relative approximate fuel value, 0.4457; weight in pounds of a cubic foot of dry wood, 27.88; relative strength, 248.

WESTERN CATALPA.

(*Catalpa speciosa*, Warder). (Sargent, Silva N. A., Vol. VI, p. 89, t. 290, 291).

Differs from the above *Catalpa* in producing a more vigorous, straight stem, in having a narrower flower, which is two inches long, almost white and nearly destitute of spots inside, and with the lower lip notched. There are posts of this species which have been in the ground for more than half a century, and which are still serviceably solid. The tree is, moreover, a very quick grower in our region, in certain places. It has made, under my observations, a diameter of trunk of twelve inches in as many years. But for general purposes in this State it does not seem to promise as much as does the ordinary species.

Its physical properties are, specific gravity, 0.4165; percentage of ash, 0.39; relative approximate fuel value, 0.4149; weight in pounds of a cubic foot of dry wood, 25.96; relative strength, 230. While considerably lighter than the ordinary *catalpa*, the western *catalpa* appears to be nevertheless the stronger of the two, and hence in so far has a wider range of utility. It should, nevertheless be said that the expectations as to its value in railroad ties have never been realized. The wood is too soft to endure the crushing weight of heavy trains very long, however well it might resist decay.

SASSAFRAS.

(*Sassafras officinale*, Nees.). (Sargent, Silva N. A., Vol. VII, *Sassafras Sassafras*, p. 17, t. 304, 305).

Ordinarily a mere shrub in Pennsylvania; occasionally reaching a height of thirty feet, and rarely becoming a large sized tree. Four such trees stand along a fence row near Wawa, in Delaware county. They will average more than three feet through at four feet above the ground. There was another such near Pughtown, in Chester county. It has recently been destroyed. Mr. Josiah Leeds has measured one at Horsham, Montgomery county, Pennsylvania, which at four and a half feet above the ground had a diameter of almost five feet.

Wood, of heart a reddish brown in color, that of the sap lighter and with a tinge of yellow. Bark of trunk light gray externally and red internally, longitudinally cleft, that of younger twigs green and somewhat spotted. Leaves, exceedingly variable in shape, varying from oval to three lobed, or having the main portion of the blade entire with a thumb-like projection or lobe on one side; from two to six inches long and, on a footstalk one-fourth the length of the leaf blade. Flowers, male and female, separated and either sex on one tree wholly; never both on the same tree; greenish yellow, arising from the same buds as the leaves and appearing at the same time—in April. The stone fruit matures in September, on a purple stalk.

The sassafras is a tree of no little historical importance. When the colony known as Gosnold's Hope located itself on the Elizabeth Islands, several years prior to the landing of the Pilgrims on Cape Cod, the returning vessels were to carry with them to England a cargo of sassafras, cedar and furs. The popularity of this new, fragrant drug was unbounded at that time in the northern country and the most extravagant estimate was placed upon its remedial power. It still finds a place in the list of drugs; "the root, and especially its bark, enters into commerce, affording a powerful aromatic stimulant." *Sassafras* wood is employed chiefly because of its power of resisting decay when in exposed places. Hence its value in construction of small vessels, especially for the keels, and for fence posts and rails.

This tree ranges from Massachusetts south to Florida and west to Indian territory and Texas. During the winter, in the leafless state, it may be recognized at a distance by the mass of upturned twigs that are found on any thrifty representative of the species.

Physical properties, specific gravity, 0.5042; percentage of ash, 0.10; relative approximate fuel value, 0.5037; weight in pounds of a cubic foot of dry wood, 31.42; relative strength, 242.

SLIPPERY ELM, RED ELM, MOOSE ELM.

(*Ulmus fulva*, Michx.). (Sargent, *Silva* N. A., Vol. VII, p. 53, t. 314).

This tree seldom attains in Pennsylvania a height of more than sixty feet, or a diameter of more than eighteen inches. Its heart wood varies in color from brown to red; the sap wood is lighter in hue. From its general character one might well suppose that it would furnish a timber of the very first class, being hard, heavy, strong and very durable under exposure. The outer bark is dark, moderately furrowed and inclined to be "stringy." The inner bark, which is distinctly fibrous, abounds in a mucilaginous principle which renders it very valuable when ground, and used alone, or in combination with flaxseed, for making a soothing poultice to inflamed surfaces. Leaves, on short footstalks, ovate or oblong, somewhat heart-shaped at base, tapering to a point, very rough on upper surface, margin conspicuously and irregularly toothed; from two to six inches long. Flowers, inconspicuous, appearing in April (before the leaves), in small clusters on the sides of the branches, with short footstalks, sometimes male and female flowers on the same tree, sometimes not. Fruit, orbicular, winged all around the central seed part, cleft at apex, entire body being almost half an inch in diameter and veiny; matures in June. In winter one may distinguish this elm from the ordinary elm by the large, thick buds which are covered with a reddish down. There is considerable diversity of opinion as to the value of this wood. Sargent, whose opportunities for observation on this point have been most extended, says, "It is used for wheel-stock, fence posts, rails, railway ties, sills, etc." The slippery elm grows naturally from the Saint Lawrence to Northern Dakota, and south to Texas and Florida. With us its favorite place of growth is on rich, low, moist lands; though it also flourishes on a dry, limestone hill side.

Physical properties, specific gravity, 0.6956; percentage of ash, 0.83; relative approximate fuel value, 0.6898; weight in pounds of a cubic foot of dry wood, 43.35; relative strength, 106.

WHITE ELM, WATER ELM, AMERICAN ELM.

(*Ulmus Americana*, L.). (Sargent, *Silva N. A.*, Vol. VII, p. 43, t. 311).

This tree in New England is the "most massive specimen" of plant life of the region. It occasionally in Pennsylvania obtains a height of eighty feet and has a diameter of trunk of four feet. The top, too, spreads out until in its best condition it is among the most conspicuous of our trees. It would, however, hardly be fair to say that it surpasses, in Pennsylvania, our largest white oaks, buttonwoods, or even silver or sugar maples. Wood of the heart is brown, that of the sap is almost white. Buds not hairy. Young branches smooth. Bark is light colored, moderately cleft into elongated ridges. Flowers appear in April, before the leaves, in clusters, each flower drooping on a slender, thread-like footstalk, male, female, or perfect, as may happen on any given tree. Fruit oval, cleft at apex with the horn-like segments bending inward to close the opening between them, fringed with delicate hairs around the margin, matured in June. Leaves, broadly oblong, or oval, three to five inches long, taper pointed, unequal at base, margin toothed, smooth, or soft hairy on lower surface, upper surface smooth, or nearly so, in marked contrast with that of the rough, hairy leaf of the slippery elm.

This species of elm has inspired Emerson to produce a description which might well be called a prose poem. His description in his "Trees of Massachusetts" (edition of 1846, page 286 to 294), is one over which any lover of trees might well linger. It is, however, to be remembered that the elm there is most glorious by comparison with the other species of the region. In this State it is, as observed, less conspicuous. There are well known examples where it is famous for its beauty in Pennsylvania, but on the whole it is not better adapted to ornamental purposes than several other species that are native to our hillsides.

The elm is in its branching gracefulness a law unto itself. Whether it sends up a clean trunk forty or fifty feet and then divides into two or three main divisions, or whether it branches into several leading shoots from near the ground, it is always superb. The smaller branches arch out from the main trunk, then as they divide into smaller divisions, droop until we find a form whose perfections surpass those of the weeping willow and almost equal it in the long, pliant hanging branchlets. The chief objection to the elm is the attraction its leaves offer to insects during the summer months. It is at times almost shorn of its leaves. No tree shows more plainly than the elm does the effect of situation upon its shape. In the woods it does as other vigorous trees do—that is,

carries its main trunk up unbranched for fifty feet. It only begins to branch when it has overtopped the neighboring trees. I know of one elm growing in a dense maple grove and it is branchless for sixty feet: but the typical elm of New England, as now recognized, is a tree of round head. This could not have been its shape when the country was in forest. We may consider the elm form of to-day a product of civilization. It is more than doubtful whether the modern form of elm existed a few centuries back.

I was hunting a bit of wood on one occasion, for a place where its tendency to resist splitting would have been most severely tested. "Take that piece of alum," said a workman who stood by, "that will never split." It was the ordinary white or American elm, but my friend had recognized that it would stand the test, as it did. This and the rock elm (*Ulmus racemosa*), have their fibers well interlaced and twisted, and it explains the special fitness of the wood for such work as making plow beams, wheel hubs, saddle trees, flooring and keels and planks for boats and small vessels.

Physical properties, specific gravity, 0.6506; percentage of ash, 0.80; relative approximate fuel value, 0.6454; weight in pounds of a cubic foot of dry wood, 40.55; relative strength, 114. The American elm grows from New England to Florida and west to the Rocky mountains. It is of rapid growth and prefers, but does not require, damp ground.

I am not aware that *Ulmus racemosa*, rock elm, grows in this State.

HACKBERRY, SUGAR BERRY.

(*Celtis occidentalis*, L.). (Sargent, Silva N. A., Vol. VII, p. 67, t. 317).

A large, hardy tree, by no means common in Pennsylvania, frequently attaining a height of eighty feet and a diameter of two feet. Its wood is neither hard nor strong, but heavy and coarse-fibered, polishing fairly well; that of the heart yellowish, that of the sap lighter in color. The gray bark of the hackberry is peculiarly roughened into well-marked folds, or edges, so that it is always recognized after being once seen. The branches by their drooping tendency proclaim a relationship to the elm. Leaves, rather thick and somewhat rough, seldom more than three inches long, and two inches wide, are obliquely wedge-shaped at base, or somewhat heart-shaped, toothed along the upper half, and tapering to a point, which

is not toothed; on short footstalks. Flowers, small, appear in June and arise singly on footstalks, which are half an inch or more long, from the axils of the leaves, yellowish green in color. Fruit, a little over a quarter of an inch in diameter, round, yellowish, green, sweetish and having a central stone.

This tree varies very much in its general characters and also in the character of the soil on which it grows. Along the rich alluvial banks of the Juniata, it attains its largest size. Yet in Chester county it frequents the slaty hills of the Great Valley. As an ornamental tree the hackberry is worthy of a place on our lists. It is, however, very seldom seen on the lawns or planted by the waysides. It ranges in one form or another over an immense area, from the Saint Lawrence to Dakota and from Florida to Texas.

In spite of its size, no great use is made of the wood. I have never seen it used for any purpose. Professor Sargent says, it is used "for fencing and for the manufacture of cheap furniture." A possible explanation of the fact that it is so seldom used may be that though it grows over a wide geographical range, it is no where abundant enough to have an important place or to have had its value, if, it had any, appreciated.

The physical properties, specific gravity, 0.7287; percentage of ash, 1.09; relative approximate fuel value, 0.7208; weight in pounds of a cubic foot of dry wood, 45.41; relative strength, 142.

OSAGE ORANGE, BOW WOOD, BOIS d' ARC.

(*Maclura aurantiaca*, Nutt). (Sargent, Silva N. A., Vol. VII, *Toxylon pomiferum*, p. 89, t. 322, 323).

A large and valuable tree, introduced into Pennsylvania from the southwest (Texas and Arkansas), attaining here under exceptional circumstances a height of fifty feet and a diameter of from three to four feet. The wood possesses about every desirable quality, hard, strong, elastic, durable, and polishes well, that of the sap light yellow, of the heart a bright golden yellow. Bark moderately roughened into elongated somewhat curving ridges, on which even the outer layers have a more or less "stringy" appearance. Leaves from three and a half to four inches long, somewhat thick, shining on upper surface, a little hairy on lower surface, pointed at tip and round at base. Flowers appearing in May, male and female separated and on different trees. The males in elongated loose clusters; the females clustered and united on a fleshy receptacle forming.

when matured in October, a round mass two to four inches in diameter, from which, when broken, a milky fluid exudes. Roots covered with a bright yellow bark, and occasionally somewhat troublesome from their tendency to spread.

The osage orange was introduced into this State as a hedge plant for which it is particularly adapted because of the sharp thorns on the slender branches, and also by its rapid development and by its hardness. The chief difficulty is to restrain its luxuriant growth within proper limits and to prevent its spreading. When allowed to grow, on open ground, to tree size it makes a round-topped mass of limbs which droop somewhat toward their extremities. From the inner bark a fine flax-like fibre may be obtained. The wood though making good wheel stock has not been found so desirable as our best hickory. It is especially adapted from its solidity and its durability to railroad ties, paving blocks and posts. I can see no reason why it should not also be well adapted to making treenails for fastening ship's planking, and for which locust is ordinarily used. It should also make good "ship timbers" and from its capacity for polishing it should also be well adapted to the work of the cabinet maker. The reason of all its good qualities will probably be explained in part by the following:

The physical properties, specific gravity, 0.7736; percentage of ash, 0.68; relative approximate fuel value, 0.7683; weight in pounds of a cubic foot of dry wood, 48.21; relative strength, 27.

RED MULBERRY.

(*Morus rubra*, L.). (Sargent, *Silva* N. A., Vol. VII, p. 79, t. 302).

A small tree, seldom more than twenty-five or thirty feet high, and a foot and a half in diameter in Pennsylvania. Wood light, soft and weak, but lasting well in exposed situations, sap wood rather light colored, that of the heart yellow with a tinge of red. Gray bark somewhat deeply furrowed. Leaves on short footstalks, almost orbicular, somewhat unequally heart-shaped at base, margin with blunt teeth, tip taper-pointed, from four to eight inches long and almost as wide, rough-hairy on upper surface and soft-hairy on lower. Flowers appear in May; usually males and females on different flowers on the same tree; though sometimes both sexes in the same flower, or sometimes wholly separated, and on distinct trees; males in elongated clusters one to two inches long; females in shorter, thicker, more fleshy clusters. Fruit which matures in July

is a dark red, juicy mass forming an elongated compound berry, having very pleasant, sweet taste, and being very attractive to "birds, as well as to people." The red mulberry tree has enjoyed a wide reputation and occasioned much diversity of opinion as to its merits as a lumber. For example, the "he mulberry" is supposed along the James river to furnish a better wood than the other sex, though it is quite probable the opinion might be reversed by the mechanics of the next county. When it can be found large enough it is in great demand for the keels of small vessels, and also for ribs or "timbers." It is also said to be exceeded in value as a material for treenails by no other native wood, except locust. A barrel made of mulberry staves is supposed to be a better receptacle for such mineral waters as the "Bedford" than one made from other material.

Physical properties, specific gravity, 0.5898; percentage of ash, 0.71; relative approximate fuel value, 0.5856; weight in pounds of cubic foot of dry wood, 36.76; relative strength, 147.

The introduced species of mulberry is so inferior to our own that as a timber it hardly merits description or comment here.

BUTTONWOOD, SYCAMORE.

(*Platanus occidentalis*, L.). (Sargent, *Silva N. A.*, Vol. VII, p. 102, t. 326, 327).

One of our largest native trees. In the "Wabash flats" it has attained dimensions which entitle it to rank among the largest vegetable productions of the globe. In Pennsylvania, though smaller than along the bottom lands of the west, it still reaches, occasionally, a height of one hundred feet and a diameter of five or even six feet. Wood of sap almost white, that of heart reddish, or reddish brown; silver grain very conspicuous and from this reason the wood is hard to split (at right angles to the silver grain). Bark, on younger parts of the trunk greenish yellow, in older portions the flakes of bark leave a conspicuous white surface when they fall off. On the base of the trunk the bark is brown and marked by rather small fractures. Leaves, from four to eight inches long, somewhat wider, heart-shaped at base, often from three to five-lobed, deeply toothed, somewhat rough and hairy; footstalks two or three inches long, hollow at base and in autumn covering the young buds of the following year (as an extinguisher does a candle). Flowers, both sexes on the same tree, but in distinct heads that droop from long, thread-like stalks, the female heads being the larger and forming the familiar "button balls" seen on the tree in autumn. These mature balls are an inch in diameter and made up of a mass of seeds and chaffy scales.

The buttonwood tree naturally prefers low, wet ground, though some of the most luxuriant and largest sized specimens grow on high, dry ground. Its growth is very rapid. The most serious, indeed, the only serious objection to the buttonwood as a lawn tree is its tendency to become a mass of thick, dwarfed branchlets, from bad nutrition of the tree, caused by the late frost destroying the young leaves and the consequent necessity of forming a new set during the growing season. Fungal and insect attacks cause the same deformity. As a lumber, the range of utility for the buttonwood is very limited, its greatest commercial value being for the manufacture of tobacco boxes. It was once used largely in making butchers' blocks (a better substitute is now found in birch), and for ox yokes, comparatively few of which are now demanded, and in the manufacture of "cheap furniture." Grows from southern Maine to Florida and west to Kansas and Nebraska.

Physical properties, specific gravity, 0.5678; percentage of ash, 0.46; relative approximate fuel value, 0.5652; weight in pounds of a cubic foot of dry wood, 35.39; relative strength, 231.

BUTTERNUT, WHITE WALNUT.

(*Juglans cinerea*, L.). (Sargent, *Silva N. A.*, Vol. VII, p. 111, t. 330).

A middle sized tree, seldom more than fifty feet high and a foot and a half in diameter with us, though occasionally reaching a diameter of four or five feet. Wood, of heart from light to dark brown, of sap, lighter in color; soft, weak, brittle, taking a fine "satiny" polish. Bark, light gray, with oblong spaces between the clefts, which do not run into each other. Leaves, compound, made up of from fifteen to seventeen leaflets, each of which is broadly lance-shaped, round at base and pointed at tip and toothed along the margin, the under surface being downy. Flowers in May, both sexes on same tree, but always separated; the males in long, drooping, green, scaly clusters; the females in clusters of from four to seven, or often single, oblong, hairy and clammy. Mature fruit in September from two to three inches long with a dark brown covering to the sharp-grooved nut.

The butternut has never been an important tree in the State, though its minor uses have been many. Its half-grown nut while still soft has long been a favorite "pickling fruit." From the bark and nut shells a dark brown dye has been made to color wool. The wood makes a beautiful gun stock which in some respects is superior

to black walnut, and in the manufacture of furniture it is greatly esteemed. It is used for coffins and wooden bowls, for coach panels, posts and rails and for house finishing. Some very large logs of this species have been exported from West Virginia. The inner bark of the root yields a safe and efficient cathartic. Grows from New Brunswick to Georgia and west to Kansas and Arkansas.

Physical properties, specific gravity, 0.4086; percentage of ash, 0.51; relative approximate fuel value, 0.4065; weight in pounds of a cubic foot of dry wood, 25.46; relative strength, 245.

It prefers moist soil, but is often found on dry ground—quality of soil seems to be of minor importance.

BLACK WALNUT.

(*Juglans nigra*, L.). (Sargent, Silva N. A., Vol. VII, p. 118, t. 331, 332).

One of our largest and (formerly) most important trees, but now commercially of less consequence because almost exterminated. Sometimes eighty feet high, and four feet through. Wood, hard and heavy, strong but brittle, after a given strength is applied. Works readily and polishes beautifully. Color of heart, brown, becoming a deeper, richer hue with age; that of sap almost white. Bark, dark, deeply furrowed. Leaves, compound, of fifteen to twenty-one leaflets, which are two to four inches long, unequally rounded at base, sharp, taper-pointed, with margins sharply toothed; just a little downy. When bruised, these leaves emit a somewhat pleasant, pungent odor. Flowers appear in May, males and females separated, but on the same tree, the males in scaly clusters two inches long and less than half an inch thick, on a common footstalk. Mature fruit in October, round, two inches in diameter and inclosing within the fleshy shell an almost round, grooved, hard-shelled nut, whose oily, strong-flavored kernels are considered by many quite a delicacy.

When by any serious accident the nutrition of the black walnut is interfered with, fruit may be formed with an outer husk split into four divisions, as is that of the related (but biologically inferior) type—the common hickory nut.

The history of the walnut tree is one of singular interest. To begin with, the so-called English walnut is not a native of England, but came to that country from the Orient, and probably from Southern Europe through Germany. The term walnut is simply a cor-

ruption of the German name, which means the "foreign nut" and so designated because it came into Germany from abroad. The value of the wood in certain kinds of work soon became recognized. This was especially the case in the manufacture of furniture. When the walnut supply of Europe became scarce the American black walnut was used as a substitute. Hence it will appear that the fondness for black walnut as a furniture wood is no mere evanescent fad, but a matured taste which has an antiquity so great that its standing is assured. There is another singular fact in connection with the walnut history. For a long time our various species of hickory trees were called walnuts. This is still the case with the shell-bark trees in portions of Massachusetts. The hickories, however, are native to North America, and to that alone, and we actually apply, when the hickory nut is called walnut, a term meaning foreign nut to a fruit that grows naturally in the United States and Mexico, and in no other part of the world. It requires no argument to prove that the black walnut in Pennsylvania is almost exterminated. The major part of the wood cut and sold goes abroad. In fact, its price for home consumption is almost prohibitory so far as any general use is concerned. A remarkable instance (for this country) of cultivation of the black walnut is found on the land of the Hon. J. Sterling Morton, Secretary of Agriculture. When he moved to Nebraska he planted the black walnut (fruit), and already is selling barrels of fruit, from the trees so produced, for planting in the West. It should be said here that the value of black walnut depends not on the fact that it is black walnut, but because it is a fine-grained specimen of that wood.

In some parts of the country black walnut was used as a material for posts. It was well adapted to that use so far as durability was concerned, but the waste of so valuable a wood for an inferior purpose was shameful. Making furniture and gun stocks and finishing houses are the chief purposes to which black walnut is now applied. It is an interesting fact which may now be regarded as established that the white and black walnuts will hybridize. Indeed, it may be regarded safely enough as a principle that will apply to many more groups of trees than at one time was considered probable or possible.

Physical properties, specific gravity, 0.6115; percentage of ash, 0.79; relative approximate fuel value, 0.6067; weight in pounds of a cubic foot of dry wood, 38.11; relative strength, 113. Grows from Massachusetts to Florida and west to Kansas.

SHELL-BARK, SHAG-BARK HICKORY.

(*Carya alba*, Nutt). (Sargent, Silva N. A., Vol. VII, *Hicoria ovata*, p. 153, t. 346, 347).

One of our most valuable and striking trees, often ninety feet high and three feet in diameter; wood is hard, strong and elastic, but not durable in exposed situations, nor does it ordinarily polish well; that of the heart very brown, that of the sap almost white. The bark is gray, brittle, almost flinty hard and comes off in long strips—hence the common name of the tree. Leaves compound, of five lance-shaped leaflets, each from four to eight inches long and one-fourth as wide, taper-pointed, margin toothed, with tips of teeth minutely hairy-tufted, base more or less obliquely wedge shaped. Flowers in May, sexes separated, but on the same tree; males in scaly clusters several inches long and usually three arising from a common foot-stalk; female flowers single or two or three clustered on the ends of the young branches. Mature fruit in October, including outer husk from an inch in diameter to an inch and a half (transversely), and about as long, or one-fourth longer (longitudinally). The husk splits about the time the kernel is mature and readily releases the nut, except in the case of those nuts that are defective, to which as a rule the husk adheres tightly.

In a general way the shell-bark hickory stands as the exponent of all that is good in the entire group; though as a matter of fact in some of the arts, wheel making for example, its place might well be disputed by the "pig nut hickory." No one of our native trees varies more in all of its characteristics, probably, than the shell-bark, although the whole group of hickories is an exceedingly variable one. The shell-bark prefers damp, rich soil. In fact it is commonly said that it will not grow on poor soil. Its great value has been its bane, for there remains a scanty supply of it. Another reason for the destruction of the shell-bark is found in the fact that the soil where it flourishes best is in the greatest demand for agriculture. A strong objection to the wood of this species, and indeed to all species of hickory, is its tendency to spring or bend in process of drying, unless this is prevented by mechanical means. It should be stated that once dried it tends to retain its shape. The shell-bark grows from the St. Lawrence to Central Alabama and west to Kansas and Texas. Used where strength and elasticity are required. As a fuel it is unsurpassed. The sweet nuts are too well known to require comment.

Physical properties, specific gravity, 0.8372; percentage of ash, 0.73; relative approximate fuel value, 0.8311; weight in pounds of a cubic foot of dry wood, 52.17; relative strength, 12.

BIG SHELL-BARK, BOTTOM SHELL-BARK.

(*Carya sulcata*, Nutt). (Sargent, Silva N. A., Vol. VII, *Hicoria laciniosa*, p. 157, t. 348, 349).

A large tree eighty feet high and three feet or more in diameter. It differs from the genuine shell-bark by having from seven to nine leaflets in the leaf, these being downy beneath. Professor Sargent states this species may always be recognized by the orange color of the young branches. The nut is from an inch and a half to two inches long, angular, thick-shelled. It seems to be no where common in Pennsylvania, but is found here and there in the more fertile lands along the streams. It is recorded from Chester, Huntingdon and Bucks counties, and I have also met with it along the Juniata just below Newton Hamilton, in Mifflin county. Its mechanical uses are essentially the same as those of the genuine shell-bark, though the wood ranks much lower in strength.

Physical properties, specific gravity, 0.8108; percentage of ash, 0.90; relative approximate fuel value, 0.8035; weight in pounds of a cubic foot of dry wood, 50.53; relative strength, 34.

WHITE-HEART HICKORY, HICKORY, KING NUT, MOCKER NUT.

(*Carya tomentosa*, Nutt). (Sargent, Silva N. A., Vol. VII, *Hicoria alba*, p. 161, t. 350, 351).

This is the common hickory of Pennsylvania, and unlike the two species already described it grows well on the upland rocky and poor soil. It exceeds either of the other species in height, but seldom produces so thick a trunk. The sap wood is white and forms so thick a belt that the dark heart wood is practically unimportant, except in the largest trees. Bark is close (is not shed as in the two previous species), rough. Leaves, compound, large, of seven to nine leaflets, lance-shaped, tapering gradually, wedge-like toward base, sharp pointed, slightly toothed on margin, rough hairy on lower surface. The leaves, when bruised, are apt to emit a strong resinous odor. Young shoots also hairy and resinous in odor. Male flowers appear in May in drooping scaly clusters of threes which are from three to six inches long; female flowers usually in pairs on the ends of the branches. Mature fruit in October, varies in size (in

the husk), from an inch and a half long to two and a half, the nut proper is angular, pointed, thick shelled and has a small, sweet kernel. The husk does not open clear to the base until very late in the season. Michaux calls attention to the fact that though in this region this particular species is called hickory, to the exclusion of the others, it is not more common than they are. It may have been so when he wrote, but the lapse of years has so changed the conditions that it is now by all odds the most common species, from the mere fact that it often inhabits the rougher parts where the land is often unfit for agriculture. The white-heart hickory is the one most used in the State for fuel. Its sap can be utilized for the manufacture of sugar, and from this abundance of sweet fluid the wood is probably more likely than the other species to be attacked by insects and worms. It is not so rapid a grower as the other species, and except for the fact that it may thrive on poor soil is perhaps not the best one to plant. It grows from the St. Lawrence river to Florida and as far west as Kansas.

Physical properties are, specific gravity, 0.8218; percentage of ash, 1.06; relative approximate fuel value, 0.8131; weight in pounds of a cubic foot of dry wood, 51.21; relative strength, 28.

SMALL FRUITED HICKORY.

(*Carya microcarpa*, Nutt).

Professor Britton regards this form as most closely allied to the following species. Professor Sargent too has placed it there in his *Silva*, N. A. See next species of which it is a variety *odorata*, *Silva*, N. A., Vol. VII. p. 167. It is one of those interesting forms which do much to confuse the species of an otherwise fairly clear group. It may be distinguished by having a small nut which is smooth, thin-shelled and surrounded by a thin husk.

PIG NUT, BROOM HICKORY. SWITCH BUD HICKORY.

(*Carya porcina*, Nutt). (*Sargent*, *Silva* N. A., Vol. VII, *Hicoria glabra*, p. 105, t. 352, 353).

A somewhat smaller tree with us than either of the others, though sometimes attaining, according to Darlington, eighty feet in height. Wood, of heart brown, of sap almost white. Bark close, smooth in young tree, moderately furrowed as the trees become older. Com-

pound leaves of from five to seven leaflets which are round at the base, somewhat taper-pointed, slightly toothed and from two to six inches long and about half as wide. Flowers appear in May, sexes separated, males in scaly clusters seldom more than two inches long. Mature fruit in October somewhat pear-shaped, husk thin, usually opening only half way down. Nut proper, light brown, but slightly angled, thin-shelled, kernel rather sweet. The young twigs of this species are more slender and rod-like than those of the other species.

Empirically there is no doubt that this wood is preferred over that of the shell-bark (whose scientific reputation is higher), for the purposes of the wheelwright for making axe helves, etc. It has long been known and valued in the form of "hickory withes," that is the young shoots are twisted until they become flexible and fit for using as a substitute for ropes. One frequently sees the split tops of posts (in our remoter counties) held together by these "withes." This species has much the same range of growth as the species already enumerated. Prefers (in Pennsylvania) damp grounds. Said to prefer (elsewhere) higher grounds.

Physical properties, specific gravity, 0.8217; percentage of ash, 0.99; relative approximate fuel value, 0.8136; weight in pounds of a cubic foot of dry wood, 51.21; relative strength, 44.

BITTER NUT, SWAMP HICKORY.

(*Carya amara*, Nutt). (Sargent, *Silva N. A.*, Vol. VII, *Hicoria minima*, p. 141, t. 340, 341).

From sixty to eighty feet high and almost three feet in diameter. Wood, strong and heavy; young twigs slender, orange green, dotted; buds yellow colored. Bark, in younger trunks smooth, finally more or less split and fissured. Leaves, ordinarily with seven or nine leaflets, which are lance-shaped, taper-pointed, especially at apex, inconspicuously toothed, lower pairs much smaller than upper ones. Flowers in May, males in long, very slender, scaly, drooping clusters, which are a little downy; female flowers on the ends of the young branches, single or in pairs. Mature fruit in October, an inch in diameter, with a thin husk abundantly sprinkled with yellow dots, opening about half way to base and with more or less elevated ridges at the open clefts. Shell of nut, proper, thin; kernel intensely bitter, so that, as Emerson remarks, the "squirrels refuse to feed on it while any other nut can be found, and even boys will not eat it." This species has much the same range that the others have.

and its wood in general resembles that of the other hickories, it is good, though probably not the best of the group. With us it grows most commonly along the bottom lands, and certainly reaches its finest form and largest size there. In view of the fact that it is no better than the other hickories and demands the best land, it is not one of the species whose cultivation is especially desirable. It might be added here that greater attention should be given to reproduction of the shell-bark, the mocker nut and the pig nut hickories. It should also be added that in endeavoring to produce shell-bark trees with the best quality of fruit one cannot depend upon the seed coming true. A fine quality of fruit may be planted and a very inferior product obtained, just as in the case of producing apples, for example, from seed.

Physical properties, specific gravity, 0.7552; percentage of ash, 1.03; relative approximate fuel value, 0.7474; weight in pounds of a cubic foot of dry wood, 47.06; relative strength, 32.

GENERAL PRELIMINARY STATEMENT CONCERNING THE OAKS.

The oaks constitute so important a family of trees in this Commonwealth that it may be well to make some general statements concerning them before calling special attention to the peculiarities of the particular species which are native to our region. This group attains its greatest importance in the Northern hemisphere; indeed it may be said to have influenced the course of history more than once, and to have suggested special legislation. The position of England as "Mistress of the Seas" is, more largely than we are apt to suppose, due to the abundance of good oak for ship building purposes which her forests afforded. Under the name of pannage, rights were once given to allow swine in forests when acorns were abundant and ripe. In our own country, until iron was generally used in the construction of vessels, the government protected for its own use large bodies of live oak in the southern United States. Indeed, we may call special attention here to the fact that when England was in the throes of a prolonged Northmen invasion the invaders were always repulsed when they met the Briton in the oak forests; and almost, or quite, a century elapsed before they (the invaders) obtained any considerable foothold on the island, and then only when the water ways were opened and the foe enabled to reach important positions without traversing the oak and beech forests.

North America is especially favored in the number of species of oaks which grow here, and also in their individual abundance and in the quality of timber that they produce. In general, we may define the oak group thus:

Trees of large size, generally with the male and female flowers appearing in May, separated, but both sexes on different portions of the same tree. Male flowers inconspicuous, in long, slender drooping, scaly clusters; female flowers (of which the acorn is a type) in small round clusters, often in maturing reduced to a single one; fruit matured in October, generally, and consists of a nut or acorn enclosed in a more or less hard and scaly cup. Flowers are usually greenish. In some species of oak the fruit is matured the same year in which it starts. In others, it is formed in one year and matured in the following season. The first are called Annual-Fruited Oaks, and the latter Biennial-Fruited.

The division is a good one to adopt in the following description, and we begin with Annual-Fruited Oaks. These have whitish or pale bark; lobes or teeth of the leaves rather blunt pointed and never bristle pointed; wood of good quality.

WHITE OAK.

(*Quercus alba*, L.). (Sargent, *Silva N. A.*, Vol. VIII, p. 16, t. 356, 357, 358).

At present the most important tree of our State, after the hemlock, and varies greatly in size and shape, according to place of growth. It will grow on any land not absolutely rocky, though it attains its largest size and produces its best wood on alluvial soil. It does not prefer a limestone soil (nor does the chestnut), neither will it do as well on it as on that of another character. Darlington speaks of it as reaching one hundred feet high in Chester county. This is very unusual in Pennsylvania. He also gives its diameter at from two to five feet. It should be stated here that the very tall white oaks with us seldom have the largest diameter. It is not unusual to find trees of this species in New Jersey which vary from five to eight feet in diameter. They are, however, ordinarily of the lower and more branching form, typical of the open ground. Wood, of heart brown, of sap lighter. Bark ash colored, somewhat

deeply cleft into more or less oblong plates or masses. Leaves, in general outline somewhat oblong, broader toward the tip, more or less deeply six to ten-lobed, footstalk, half to three-fourths of an inch long, deeper green on upper than on lower surface. Flowers, in May, males in slender drooping clusters from one to three inches long, which arise four or five together from scaly buds on the end of the young branches. Acorns matured in October, from three-fourths of an inch to an inch long; cup about one-fourth of an inch deep.

There is a marked tendency to variation in the shape and lobing of the leaves of this tree, and, indeed, on different branches of the same tree. I have especially noticed the latter fact on some trees that grow on poor soil. So, too, there are marked differences in the quality of wood of the different specimens of white oak. In general, it may be stated that white oak which has a large year's growth is stronger and usually more valuable than that which has the smaller annual ring. This fact should be emphasized, because it is contrary to the opinion commonly held. It is thus to be expected that white oak grown on good, strong soil would be of better quality than that grown on poorer soil. This is unquestionably true and may be said to be a fact that has been proven not only by scientific examination, but empirically as well. Sea-going vessels built from white oak obtained in the lowlands of Delaware and Maryland are very "long-lived." To enumerate the uses of white oak would transcend the limits of this description. It may be briefly said that in almost every instance where weight, strength and durability are required, white oak may be used to advantage. As an interior finish for houses and for the purpose of the cabinet maker it is especially ornamental when sawed so as to bring the silver grain to the surface; this being the well-known quartered oak. White oak saplings make good hoops, and young, vigorous second growth wood of the same species is of great value in wheel work. The white oak grows more or less abundantly from Maine to Florida, and from the Atlantic back to western Missouri.

Physical properties, specific gravity, 0.7470; percentage of ash, 0.41; relative approximate fuel value, 0.7439; weight in pounds of a cubic foot of dry wood, 46.35; relative strength, 89. Good American white oak is slightly exceeded in strength by the English oak; just as the latter is by the product of France.

POST OAK, IRON OAK, BARRENS WHITE OAK.

(*Quercus stellata*, Wang). (Sargent, Silva N. A., Vol. VIII, *Quercus minor*, p. 37, t. 368, 369).

Seldom more than fifty feet high and from a foot to eighteen inches in diameter. Wood is hard, heavy, strong and durable; that of sap lighter in color than the brown heart wood. Bark rough, grayish white, and deeply cleft into oblong pieces. Leaves from four to six inches long, deeply and bluntly five-lobed, with greatest width (three to five inches) just back of the terminal lobe. Young branches and under surface of the leaves are usually densely covered with a brown down. The leaves are thick and the whole tree suggests the name of "rough oak," which is occasionally given to it. Acorn, half to two-thirds of an inch long, half immersed in the cup, rather sweet.

This little tree grows on thin soil, and is found from Southern Massachusetts to Northern Florida, and west to the Texas "Cross Timbers." Its durability is suggested in the name post oak by which it is here most commonly known. If the trunks of these trees were larger, the planks made from this species would be very valuable. It is prized for certain kinds of ship carpenter work, also for ties and fuel.

Physical properties. specific gravity, 0.8367; percentage of ash, 0.79; relative approximate fuel value, 0.8301; weight in pounds of a cubic foot of dry wood, 52.14; relative strength, 104.

BUR OAK, MOSSY-CUP OAK, OVER-CUP OAK.

(*Quercus macrocarpa*, Michx.). (Sargent, Silva N. A., Vol. VIII, p. 43, t. 371, 372, 373).

A noble, spreading tree, by no means common in Pennsylvania (certainly at least not in the eastern half, except where introduced), usually under seventy feet high here, and almost as widely branched. Wood, of heart brown, heavy, strong and very durable. Bark rather dark gray, not much cleft, inclined to shell off in thin flakes. The leaves are pear-shaped in general outline, with three or four round-pointed, deep lobes on each side, commonly velvety and hairy on under surface until latter part of summer when they

become almost smooth. Michaux speaks of the leaves being sometimes fifteen inches long and eight wide. We have never seen anything approaching that. The leaves have seldom exceeded eight inches in length and are usually less than half as wide. The acorn is large (almost an inch), round, and immersed about half this length in a cup whose margin is more or less conspicuously fringed by the slender points of the scales. This species does best along the lower Ohio river, on rich alluvial land. I have occasionally met with it in similar positions along the banks of the Juniata, in Mifflin county. It is also reported from Lancaster county. It ranges from Nova Scotia west to the Rocky mountains, and from Pennsylvania southwest to Texas. It exceeds the white oak in value for purposes of construction, being both stronger and more durable.

Physical properties, specific gravity, 0.7453; percentage of ash, 0.71; relative approximate fuel value, 0.7400; weight in pounds of a cubic foot of dry wood, 46.45; relative strength, 68.

SWAMP WHITE OAK.

(*Quercus bicolor*, Willd.). (Sargent, Silva N. A., Vol. VIII, *Quercus platanoïdes*, p. 63, t. 380, 381).

A large, variable and valuable oak which is, or has been, moderately common in this State, attaining a height of seventy feet (or rarely more) here, and a diameter of two feet. Bark is light gray, moderately cleft, and somewhat inclined to separate in flakes from the outer portion. Clefts in the bark are often so long, and spiral in direction near the base of the tree, that it appears as though the trunk was struck by lightning. Leaves pear shaped, margins hardly lobed, but rather deeply wavy-toothed, under surface olive green, often soft, velvety, hairy, and upper surface smooth and reddish green. Acorns about an inch long, oval, immersed one-fourth their length in the cup, usually growing in pairs on a leafless stalk which is from one to four inches long. One might infer from the name of this species that it flourished in swamps and there alone. It is true that it prefers a moist situation, but on the other hand I have occasionally found it growing on exceedingly dry locations, and apparently doing as well there as any of our native oaks. Tree ranges from Maine to Ontario and south almost to the gulf. In its qualities it has almost the same value and uses as the white oak, which it closely resembles.

Physical properties, specific gravity, 0.7662; percentage of ash, 0.58; relative approximate fuel value, 0.7618; weight in pounds of a cubic foot of dry wood, 47.75; relative strength, 85.

THE BASKET OAK, COW OAK.

(*Quercus Michauxii*, Nutt). (Sargent, *Silva N. A.*, Vol. VIII, p. 67, t. 382, 383).

Has not, so far as I am aware, been reported from Pennsylvania, though it has been found in New Castle county, Delaware, and may yet come to light within our borders. It is a large and valuable tree and the sweet acorns are eaten by domestic animals.

CHESTNUT OAK, ROCK CHESTNUT OAK.

(*Quercus Prinus*, L.). (Sargent, *Silva N. A.*, Vol. VIII, p. 51, t. 375, 376).

A most valuable and characteristic tree of our mountain regions, especially south of, say, latitude forty-one degrees and twenty minutes north. It varies in size from fifty to sixty feet high and from eighteen inches to two feet in diameter. The wood is strong, heavy and durable, but splits readily in drying or in working; that of the heart is dark brown or red, the sap wood being, of course, lighter colored. The bark varies very much in appearance, according to age and place of growth. An old chestnut oak growing on a very rocky soil has a very thick, much fissured, gray or dark gray, or sometimes brown bark which is often almost completely covered with lichens. Leaves, rather thick, from three to eight inches long, about one-half as wide, oblong in outline and with the prominent veins each ending in a conspicuously blunt tooth or projection (which, however, has not a glandular tip). Between these veins is a multitude of veinlets which (seen best on under surface of leaves) run at right angles to and from one vein to the other; footstalk of leaves from one-quarter to three-quarters of an inch long. Mature acorns from three-fourths of an inch to an inch and a quarter long, oval, im-

mersed a third of their length in the rough scaly cups, yellow at first then dark brown, sweetish to the taste. The group of chestnut oaks is one of the most perplexing. I find along the Juniata, near McVeytown, a form occasionally where the leaves are longer, almost as deeply lobed as in some white oaks, which seem to me clearly to belong to this species. In rapidity of growth the chestnut oak shows many anomalies. For example, I have seen one instance where the age of the trees was known to be inside of fifty years, though they were from fifteen to eighteen inches across the stump. On the other hand, I would find that on a rough mountain side a century and a half had been required to attain a like size.

The rock oak or chestnut oak, as it may be called, is among our most valuable trees for two reasons; first, because it will thrive on soil that is so poor and rocky that very few other species of tree will grow there. This tree and the chestnut, the locust and the pitch pine form a set of congenial associates, well adapted to such hardy surroundings. It is also useful because it furnishes a valuable, durable timber, especially for railroad ties, a good fuel, and a bark greatly prized by the tanner. The acorns are eagerly eaten by swine and bears.

Physical properties, specific gravity, 0.7499; percentage of ash, 0.77; relative approximate fuel value, 0.7441; weight in pounds of a cubic foot of dry wood, 46.73; relative strength, 50.

YELLOW OAK.

(*Quercus Muhlenbergii*, Engelm.). (Sargent, Silva N. A., Vol. VIII, *Quercus acuminata*, p. 55, t. 377).

This tree is said by Ridgway to attain in the Wabash valley a height of one hundred and fifty-five feet, and to have a circumference of twelve feet. It is by no means as large in Pennsylvania. I have never seen it more than eighty feet high. In open spaces it branches freely, but its branches are more gnarled and "kinky" and lacking, therefore, in the grace of a well branched white oak. Wood of good quality, yellowish; bark, spoken of in Gray's Manual as thin and flaky, probably only true of trees that have not attained full size. Adult specimens here have a thick, rough bark. Leaves, in general, lance-shaped, sharp toothed, like a chestnut leaf, with a very small callous tip to each tooth; on a footstalk from half an inch to an inch and a quarter long; under surface downy and gray; upper surface smooth and green. Fruit, acorn, less than or about three-fourths of an inch long, oval and immersed less than one-third its length in the shallow cup; sweet and edible.

There is such a confusion of terms and of ideas concerning these rock oaks that it is almost impossible to give an exact estimate as to the relative value of this or that special form. This, of course, all grows out of the fact that the trees themselves vary constantly according to soil, situation and possibly also from hybridization. In general terms, however, we may say that the rock oak wood and bark are valuable.

Physical properties, specific gravity, 0.8605; percentage of ash, 1.14; relative approximate fuel value, 0.8507; weight in pounds of a cubic foot of dry wood, 53.63; relative strength, 6.

It must be borne in mind that owing to lack of fixed ideas as to what constitutes *Quercus Muhlenbergii* the above statement of physical properties is given as approximate only. The typical yellow oak is by no means common in Pennsylvania.

All the oaks described thus far have produced and matured their acorns in one year. Those that follow require two years, and ordinarily on the same tree one may find both sizes of fruit. The Biennial-Fruited oaks may be thus characterized: Bark dark, often almost black; leaves, with acute tips to lobes, which are bristle-pointed; fruit, ripening in second year; wood of inferior quality.

RED OAK.

(*Quercus rubra*, L.). (Sargent, *Silva N. A.*, Vol. VIII, p. 125, t. 409, 410).

A rather common tree in Pennsylvania, attaining sometimes a height of more than eighty feet, with a diameter occasionally of five feet. Four feet is by no means rare. Wood, of heart distinctly reddish; that of sap dark brown, very hard to season. Bark of trunk, in old trees, dark brown, considerably fissured; that of trunk in younger trees and on chief limbs almost smooth, and gray in color, with a greenish tinge. This characteristic is the one by which it is generally most easily recognized. Leaves, large, thin, from four to nine inches long, and a little more than half as wide; foot-stalks from one to two and a half inches long, about three large lobes on each side of leaf, these sharp, bristle-tipped and each with smaller, bristle-tipped lobes; color above quite green, and smooth. lower surface lighter colored. Mature acorn about an inch long

and three-fourths as thick, tapering rather suddenly to a point and immersed about one-fourth its length in the very shallow cup; eaten by pigs, but rather bitter.

This is perhaps the most rapid grower of all the oaks. I counted the rings on a trunk which was just four feet across and failed to recognize more than one hundred and eighty years growth. Owing to the condition of the wood, I was not able, in some instances, to be quite sure as to presence or absence of a ring. I am, however, certain that the age was not greater than indicated. A hemlock, but a few inches larger, had five hundred and fifty-two annual rings. The wood of the red oak has a certain limited use in house finishing. It should be added, however, that the lumberman does not always obtain this red oak from what could be botanically identified as a representative of the species. Any large-sized oak with a reddish fibre will meet the demand of the market. Red oak is apt to corrode iron spikes driven into it, hence there are places for which the wood is practically unfitted. It is also used in coarse forms of cooperage, but the wood is too open-pored to make a really first-class stave.

This species extends further north than any other of our American oaks, and is much more common north than south. It may also be said that it is much more frequently met with in the cooler parts of this State than elsewhere in our borders, though in spite of its choice of cool situations it does extend as far south, sparingly, as northern Florida and west to Kansas. As an ornamental tree the red oak takes high rank. Its rapid growth, ample expanse, large, green, fresh foliage, make it a peculiarly attractive tree.

Physical properties, specific gravity, 0.6540; percentage of ash, 0.26; relative approximate fuel value, 0.6523; weight in pounds of a cubic foot of dry wood, 40.76; relative strength, 66.

Leaves in autumn turn dark red. Will flourish on the poor soil of a mountain side, or on a rich river bottom.

SCARLET OAK.

(*Quercus coccinea*, Wang.). (Sargent, *Silva N. A.*, Vol. VIII, p. 133, t. 412, 413).

Is occasionally found eighty feet high and with a diameter of three feet. Heart wood, hard, strong and heavy, reddish brown; that of the sap darker still. Emerson is very explicit in his statement as to the bark of the scarlet oak. "The bark on small trees is of a reddish, granite color, rough with numerous sharp clefts; on the older trees the bark has a bluish tinge, whereby it may be distin-

guished from that of the black oak. The recent branchlets are of a light purplish green, very smooth; older ones darker, purplish green; larger branches grayish." Inner bark reddish in color. Leaves on footstalks two inches or more long, deeply cleft, with spaces between the lobes usually as wide as, or wider, than the lobes themselves; lobes sharp-toothed and bristle-tipped; thin, smooth and shining even in early spring when most oak leaves are more or less hairy; bright crimson in autumn, and then, after the maple, the glory of our woods. Mature acorn about three-fourths of an inch long and almost as thick, sometimes slightly pointed and at other times flattened or even depressed at summit; immersed one-half in very scaly cup, which tapers downward into a short, thick stalk.

The scarlet oak is one of the most desirable of our native trees for lawns, owing to the rich autumn coloring of the leaves. It is very apt to be confounded with the black oak except at that season. Its inner bark is red and not yellow as in the black oak. The young branches of the scarlet oak impart a greenish color to the saliva when chewed, whereas those of the black oak, as Michaux long ago observed, give it a yellowish tinge. Scarlet oak makes only a middling fuel, neither is the bark especially valued by the tanner. In short, the beauty of the scarlet oak appears to be its chief merit. It ranges from Maine to Florida, and thence westward to Iowa and Missouri. As a rule, in this State, it is apt to be found on rather thin soil.

Physical properties, specific gravity, 0.7405; percentage of ash, 0.19; relative approximate fuel value, 0.7391; weight in pounds of a cubic foot of dry wood, 46.15; relative strength, 40.

BLACK OAK, YELLOW-BARK OAK, QUERCITRON OAK.

(*Quercus tinctoria*, Bartram). (Sargent, *Silva N. A.*, Vol. VIII. *Quercus velutina*, p. 137, t. 414, 415).

This important tree is common in our forests, on poor ground, but is in general aspect so like the scarlet oak just described that it has often been mistaken for it by an ordinary observer, and often considered as a mere variety of it by the botanists. In Pennsylvania it sometimes attains a height of ninety feet, and a diameter of from three to four feet. Wood, hard and heavy, but very open-pored, reddish brown at heart. Bark dark, rough, much fissured, "black within," inner bark more or less spongy, distinctly yellow, and imparting, when chewed, a yellow color to the saliva. Leaves

broadly oblong, wider toward tip, deeply lobed, with lobes usually wider than the spaces between them; teeth and lobes bristle-tipped; when young, bright scarlet colored, later covered with a grayish white down, hairy tufted on lower side where the secondary veins come off from midrib; in autumn (black oak) leaves become rusty brown instead of bright scarlet. The acorns of the black and scarlet oak are much alike in shape, but in the former the inside of the acorn cup is a rich orange yellow and the kernel of the acorn is very bitter, whereas in the scarlet oak the inside of the acorn cup is paler and the acorn is less bitter.

As a ship timber, black oak is only medium. Nails driven into the wood are likely to corrode. Wood too open-pored to furnish the best staves, still somewhat used in cooperage. The bark is highly prized by tanners, and in a small way is used medicinally as an astringent for bleeding and diarrhoea.

Has almost the same range as the scarlet oak, though it extends a little further west. Like the scarlet oak it prefers, or rather is found on, soils of poor quality.

Physical properties, specific gravity, 0.7045; percentage of ash, 0.28; relative approximate fuel value, 0.7025; weight in pounds of a cubic foot of dry wood, 43.90; relative strength, 47.

PIN OAK, SWAMP OAK, SPANISH OAK.

(*Quercus palustris*, Du Roi). (Sargent, *Silva N. A.*, Vol. VIII, p. 151, t. 422, 423).

A smaller tree than either of the biennial-fruited oaks thus far described. It seldom with us attains a height of more than sixty or seventy feet, or a greater diameter than two feet. Wood, hard, heavy and strong, with sap wood dark brown, that of heart lighter. Bark, almost smooth, i. e., not cleft, or ridged, dark gray in color. lower branches slender, drooping; branchlets so numerous as to give the tree a "twiggy" appearance. From these characteristics it may be clearly recognized in winter at a distance. Leaves, much resembling those of the scarlet oak, but smaller (see above). Acorn, almost half an inch long, globose except at base, which is almost flat; immersed one-eighth of an inch in the very flat saucer-shaped acorn cup. This tree is readily recognized by the smaller acorn and by the drooping branches. It prefers, indeed, is almost always found on swampy ground, though I have known examples of its growth on situations that were quite dry. Pin oak, when properly

cared for, makes a desirable ornamental tree. It sometimes simulates the bright autumn coloring of the scarlet oak. There is a degree of "airiness" connected with its foliage which perhaps is shown by no other oak. Economically considered, the pin oak is of some value, splitting well, it may be made into clapboards or rough shingles, and it is occasionally used by the cooper. With us it is seldom used for any purposes of general construction.

Physical properties, specific gravity, 0.6938; percentage of ash, 0.81; relative approximate fuel value, 0.6882; weight in pounds of a cubic foot of dry wood, 43.24; relative strength, 33.

The pin oak is somewhat more restricted in its range than is usual with its related species. It grows from Massachusetts to the District of Columbia and west to Kansas.

SPANISH OAK.

(*Quercus falcata*, Michx.). (Sargent, *Silva* N. A., Vol. III, *Quercus digitata*, p. 147, t. 420, 421).

The name Spanish oak is also applied to the pin oak just described. It should, however, be reserved for the species now under consideration which is only occasionally found in Pennsylvania; so far as I am personally aware, in Philadelphia, Chester and Delaware counties only. Darlington gives it a height from fifty to eighty feet. I have seen no specimen in Pennsylvania that exceeded fifty feet. In fact the representatives that I now remember having seen were still smaller, but they had the blackened, deeply furrowed look which is characteristic of a tree already old. The wood is red and open-pored, hard, heavy and strong, but not durable. Leaves variable, of two types, one with three lobes from an inch to two inches long and from a half to three-fourths of an inch wide at the base, bristle-pointed and not (or hardly) curved. The other is longer, with five sharp-pointed, bristle-tipped, curved, slender lobes. Both types are distinctly soft, downy or hairy on the under surface. Acorns half an inch in diameter, brown, immersed for one-fourth their length in a scaly cup which tapers to a short, thick footstalk. Michaux says they retain power of germination for a long time. The most important use of the wood appears to be for fuel, although it also makes an inferior grade of staves. Michaux says it was once used for fellies of heavy wheels by the Baltimore wheelwrights, a purpose for which it was doubtless well adapted because of its unusual strength.

Spanish oak ranges from Long Island to Florida and appears in the gulf states and the lower Mississippi valley.

Physical properties, specific gravity, 0.6928; percentage of ash, 0.25; relative approximate fuel value, 0.6911; weight in pounds of a cubic foot of dry wood, 43.18; relative strength, 13.

BLACK JACK, JACK OAK.

(*Quercus nigra*, L.). (Sargent, Silva N. A., Vol. VIII, *Quercus Marylandica*, p. 161, t. 426, 427).

This species can hardly be considered as common in Pennsylvania. When found it is on thin soil, and seldom exceeds forty feet in height. The dark brown heart wood is hard and heavy, but decays speedily when exposed. Bark rough, furrowed, almost black externally, and of a dull red beneath the surface. Leaves from four to eight inches long, and two-thirds as wide, wedge-shaped upwardly, or often three or five-lobed, with short bristles projecting from end of lobes, thick, rusty-hairy on lower surface, especially along the veins. The leaf is so peculiar that it can be mistaken for that of no other species. Acorn ovoid, three-fourths of an inch in diameter, inserted for almost half its length in the coarse, scaly cup. Wood of no special value, except for fuel. Grows from Long Island to Florida and west to Kansas.

Physical properties, specific gravity, 0.7324; percentage of ash, 1.16; relative approximate fuel value, 0.7239; weight in pounds of a cubic foot of dry wood, 45.64; relative strength, 46.

SHINGLE OAK, LAUREL OAK.

(*Quercus imbricaria*, Michx.).

Not more than fifty feet high and about a foot in diameter. In the valley of the Wabash it is said, by Mr. Ridgway, to grow to a height of one hundred feet, and to have a diameter of more than two and a half feet. Wood, is open pored, strong, heavy, hard and reddish brown in color. Bark smooth. Leaves from two and a half to five inches long and one-fourth as wide, neither lobed nor toothed,

blunt-pointed, tapering to the short footstalk, without bristle tips, thickish, somewhat hairy on lower surface until quite old; upper surface shining green. Acorn less than half an inch long, ovoid, immersed for one-fourth its length in a saucer-shaped cup. Not common in eastern Pennsylvania, but found near Allentown by Professor Porter, and by Michaux near Bedford. I have also found it in Somerset and Westmoreland counties. It is common south and westward. A tree of no great value. Wood used as its name indicates for shingles and much used as a fuel.

Physical properties, specific gravity, 0.7529; percentage of ash, 0.43; relative approximate fuel value, 0.7497; weight in pounds of a cubic foot of dry wood, 46.92; relative strength, 8.

WILLOW OAK.

(*Quercus Phellos*, L.). (Sargent, *Silva N. A.*, Vol. VIII, p. 179, t. 435).

The willow oak, which is so rare here as to have no commercial value, ranges from Staten Island south to Florida and west to Missouri and Texas. It may be recognized by its narrow, pointed leaves, which are from three to four inches long.

BARTRAM'S OAK.

(The So-called *Quercus heterophylla*, Michx.).

This is probably a hybrid between either the willow oak and the red oak, or the scarlet oak. Whatever may be its origin it is too rare to have any commercial importance here. It is a large tree and distinguished by the fact that its leaves vary greatly in size and in degree of lobing.

Physical properties, specific gravity, 0.6834; percentage of ash, 0.17; relative approximate fuel value, 0.6822; weight in pounds of a cubic foot of dry wood, 42.59; relative strength, 36.

CHESTNUT.

(See Plates 30 and 32).

(*Castanea sativa* Mill., var. *Americana*, Wats. & Coult.). (Sargent, *Silva N. A.*, Vol. IX, *Castanea dentata*, p. 13, t. 340, 341).

The chestnut is one of the most massive trees when given a fair chance to acquire its maximum size. It reaches, in the woods, a

height of almost or quite one hundred feet under the most favorable circumstances. In cleared lands and on a good soil it often acquires a diameter of five feet at three feet above the ground. The wood of the chestnut is light, porous, splits readily, only fairly strong, yellow or yellowish brown in color. Bark, on young trees smooth, cracking and becoming rougher with age; younger shoots green-colored. Trees on low, fertile land retain their smooth bark longer than those in harder circumstances. Leaves from five to nine inches long and about one-fourth as wide, tapering above to an acute point and at base into a footstalk ordinarily about half an inch long; margins with sharp, upwardly pointing teeth, green and smooth on both upper and lower surfaces. Flowers appear in June; males whitish in small, thready clusters on a central axis which is from five to ten inches long and which arises from the angles between the insertion of the leaf and the stem; females usually three in number enclosed within a case that matures into a prickly, round, green burr two inches or more in diameter. This contains in October usually one central, perfect, brown, shining chestnut and two others which are less perfectly developed.

The American chestnut and the so-called Spanish chestnuts are so much alike in their general character, and the gradations between them are so many that botanists have been inclined to regard them as the same species originally, and to explain the differences between them as due to situation, time and cultivation. It may be now regarded as established that the Spanish chestnut was brought into Europe from Asia (probably China originally) and that it was introduced by these conquering nations, the Greeks and the Romans from some of the regions which they had invaded. The large fruit has come to be regarded in southern Europe not simply as a delicacy, but as a substantial food; and during the later autumn months the farina of the chestnut is an acceptable table substitute for the potato. It should be remembered, however, that chestnuts are of desirable and undesirable varieties, and that it is the former that are in chief demand. The fruit of an American tree is much smaller than that of the European. There is this compensating advantage, however, the American fruit is much sweeter. It is now fairly a question as to whether our native variety may not be greatly improved by judicious cultivation. It is said, seemingly on good authority, that we import each year not less than 100,000 bushels for home use. If this is so we may consider that the time has come for raising our own chestnut crop and so improving its character as to banish the European product. There are many reasons why this tree should be cultivated:

1. It will grow on almost any kind of soil, from a river flat to a mountain top, although it is not at its best on limestone soils.
2. It grows with great rapidity.
3. If it has any enemies it withstands their attacks.

4. When cut it reproduces a valuable coppice or sprout growth in a few years.

5. Its product, wood and fruit, will always be in demand.

6. There will be an increasing demand for it in future, because of the tannin which it contains, and because the other sources of supply are fast being exhausted.

It is not generally recognized how large a diameter the chestnut tree may attain in this State. I may say that in Chester, Delaware. Lancaster and Bucks counties six feet is by no means an unusual diameter for a tree of this species at three feet above the ground. I know of several which are seven feet in diameter, and am informed by Mr. Josiah Leeds, of one which formerly grew at Horsham, in Montgomery county, where the stump still remains, and measures nine feet across the top. One tree still grows in Delaware county which is nine feet through, at four feet above the ground. Emerson states that the chestnut does not grow rapidly for the first ten or fifteen years, but that its rate of growth increases until it is fifty years old. I have made no positive observations on this point, but nevertheless am in possession of some facts that tend to sustain this statement. The famous chestnut tree on Mount Aetna was, in 1770, sixty-eight feet in diameter. The general opinion being then, as now, that it represented one tree, and not several which had grown together.

Chestnut is used for rails and posts. It is claimed that posts of this wood should be planted green (before seasoning) and with the upper end of the stick in the ground. The faith in these rather unusual conditions is so wide spread that one must regard it as worthy of consideration. Chestnut wood is now largely used for shingles, and to a considerable extent for house finishing and for the manufacture of furniture. It lasts well in exposed situations, and it makes good charcoal, but it is a very poor fuel. The chestnut tree grows from Maine to northern Alabama and as far west as Tennessee and Kentucky.

Physical properties, specific gravity, 0.4504; percentage of ash, 0.18; relative approximate fuel value, 0.4496; weight in pounds of a cubic foot of dry wood, 28.07; relative strength, 192.

CHINQUAPIN.

(*Castanea pumila*, Miller). (Sargent, Silva N. A., Vol. IX, p. 17, t. 442, 443).

Grows sparingly in Pennsylvania and has no commercial importance, and we, therefore, omit all further statements concerning it. I have found it in Lancaster and York counties.

BEECH.

(*Fagus ferruginea*, Ait.). (Sargent, Silva N. A., Vol. IX, *Fagus Americana*, p. 27, t. 444).

Reaches a height of sixty to seventy feet and a diameter of about three feet. Wood, hard, strong, tough, polishes well, but decays speedily in contact with soil, or when subjected to alternate wet and dry conditions. Wood of heart usually red or reddish, that of sap somewhat lighter in color. Branchlets slender and delicate, tipped in winter with a long, yellowish bud. Bark is a clean gray, smooth and brittle. Even in extreme old age the beech bark is but little inclined to become cracked and ridged. The leaves are oblong or ovate, except toward the base, which is wedge-shaped or slightly rounded, tapering toward the apex, when fully grown, but little if any hairiness on either surface. The young beech leaves even when fully grown are very thin, but they become markedly thicker as they become older. Flowers in May; males in hairy or scaly loose clusters which hang on delicate threads one to two inches long, originating in the axils of the leaves; females on a short footstalk, in pairs, surrounded by a scaly or somewhat prickly cup, which matures into a four-lobed, four-valved fruit in October, containing two (usually) three sided, brown nuts less than half an inch in diameter.

The beech is one of the most common hard wood trees in the elevated part of this State. No tree of our woods is more entitled to respect for an average symmetry and a constant cleanliness than the beech. There is never anything about it that suggests disreputable association, or lack of grace. We ordinarily think of it as confined to damp grounds; but while it does prefer such, it will grow in drier situations. Beech nuts are eaten by pigs, bears and wild pigeons. In the absence of chestnut, they might be even here, as in Europe, somewhat valued as a delicacy by man. Beech wood is used in manufacture of "wood vinegar." Plane stocks are made from the outer or sap wood. It is also utilized in making furniture, shoe lasts, and occasionally appears in the construction of refrigerators. As a fuel it might be rated high, and potash abounds in the ashes. There is a current belief that the beech tree is never struck by lightning. It grows from Nova Scotia to western Florida and west to Missouri.

Physical properties, specific gravity, 0.6883; percentage of ash, 0.51; relative approximate fuel value, 0.6848; weight in pounds of a cubic foot of dry wood, 42.89; relative strength, 24.

IRON WOOD, HOP-HORNBEAM.

(*Ostrya Virginica*, Willd.). (Sargent, *Silva N. A.*, Vol. IX, p. 34, t. 445).

A small tree twenty to thirty feet high and possibly a foot thick, nowhere common in this State, but evenly diffused throughout. Wood is very hard, especially when dry, elastic, and hence well known to country lads for the quality of bows it makes. Heart wood brown, often white, sap wood white; polishes well. The bark is a dark gray, split (not deeply but) into very many narrow plates (which are sometimes so regular and narrow that they look as though it might have been done artificially). No other tree of our woods at all resembles the iron wood in the character of its bark, and once seen it should always be recognized afterwards. Leaves from two to four inches long, rounded at base, on very short footstalks, acute at apex, margin very sharply and irregularly toothed, lower surface often brown in autumn, upper green. Male flowers are hanging, when they appear in May, in scaly brown clusters two inches long from the ends of the branch of the previous season. They appear at the same time as the leaves. Female flowers are on the end of a leafy branch, at first in scaly masses half an inch long in which are conical sacks each containing a seed. These sacks enlarge until in August or September they mature a brown seed about one-eighth of an inch long. The cluster of bags and seeds bears a close resemblance to a head of hops. This head is at first erect, then droops in autumn. It is then from two to three inches long. Iron wood grows from the Gulf of Saint Lawrence to Florida, and is found west as far as eastern Kansas and Texas. It would be an extremely valuable wood if larger. It is useful for cogs, levers and tool handles.

Physical properties, specific gravity, 0.8284; percentage of ash, 0.50; relative approximate fuel value, 0.8243; weight in pounds of a cubic foot of dry wood, 51.63; relative strength, 25.

WATER BEECH, HORN BEAM.

(*Carpinus Caroliniana*, Walter). (Sargent, *Silva N. A.*, Vol. IX, p. 42, t. 447).

Seldom more than twenty feet high or a foot in diameter, with many somewhat crooked branches. Trunk, short and thick, often somewhat perpendicularly ridged. Bark, smooth, a blue gray in color.

Wood, white, solid and strong. Leaves, oval, two to three inches long, round at base, sharp at tip, toothed; footstalk one-fourth of an inch to one-half an inch long. Male flowers in hanging cylindrical scaly clusters an inch or two long, appearing with or before the leaves. Female flowers arise from the same bud as the leaves, on the end of the young branch; two of these fertile flowers under a somewhat three-lobed leaf, which is less than an inch long and covers (without inclosing in a bag as in the iron wood) the small, hard nut.

The term iron wood is often given to the tree, but it should be given to the *Ostrya* described above; water beech and blue beech are expressive and characteristic names for this tree. This species is quite common in Pennsylvania, but is not found in great quantities anywhere. As our forests are reduced in area, the more important trees being taken and these less important left, the latter become relatively of more consequence. The wood of the water beech is well adapted to the purpose of the turner; polishes well and may be used for cogs, pulleys, tool handles and other like work.

This tree ranges from Nova Scotia and Michigan to the Gulf of Mexico and west to Kansas.

Physical properties, specific gravity, 0.7286; percentage of ash, 0.83; relative approximate fuel value, 0.7226; weight in pounds of a cubic foot of dry wood, 45.41; relative strength, 22.

GENERAL PRELIMINARY STATEMENT CONCERNING THE BIRCHES.

Birch trees form a group like the oaks and the hickories, by themselves. They, therefore, have certain peculiarities among themselves which no other group has, and in order to avoid repetition in describing the five species which we have in Pennsylvania, it may be well to enumerate some of the more important characteristics which they have in common. The alders to which we shall also allude in this connection may be regarded as "blood relatives" of the birches, and we will include them in what follows, thus: They are natives of the colder parts of the world. They have leaves that are alternate with each other (not opposite to each other on the same branch or twig). The male and female flowers are (like those of the oak) in separate clusters, and on the same tree or shrub. The male clusters are long (two or three or even four inches), slender, drooping, soft, scaly and usually yellow. The fe-

males are in green, brown or black (according to age), oblong or oval scaly cone-like bodies. Both sexes appear actively, of course, at the same time, in early spring, though they were well formed the season before and remain uninjured when exposed to the extremes of winter. Common in our colder, higher Pennsylvania forests, and not wholly absent from the warmer parts of the State.

CHERRY BIRCH, SWEET BIRCH, BLACK BIRCH

(*Betula lenta*, L.) (Sargent, *Silva* N. A., Vol. IX, p. 50, t. 448).

This tree in the higher parts of the State attains a height of eighty, and in exceptional cases, one hundred feet, and has sometimes a diameter of from three to four feet. Its wood is strong, dark brown or red in color, and resembles that of the cherry. The bark is dark, almost black, inclined to shell off in square flakes the size of the hand (but not to separate in horizontal sheets of large size); young branches fragrant. Leaves, ovate, heart-shaped at base, sharp toothed all around. Female cones an inch or more in length. This tree is now becoming scarce in this State from the demand already made upon it by the cabinet makers; and in addition to this the younger saplings have been cut and used for distillation of "oil of wintergreen." I frequently found these "still" during my trips in the mountainous parts of the State. Birch beer is made by fermenting the sweet sap of the tree. Emerson says that in the Green mountains black birch ranks next to rock maple as a fuel. It polishes well. The black birch ranges from the valley of the Saguenay south to Florida (in colder parts) and west to Tennessee and Kentucky.

Physical properties, specific gravity, 0.7617; percentage of ash, 0.26; relative approximate fuel value, 0.7597; weight in pounds of a cubic foot of dry wood, 47.47; relative strength, 10.

Its strength places it among the very best of our native woods. It is very valuable in the British Provinces for ship building. The fact, however, that it decays quickly is a great drawback. In some northern built vessels I have found the birch wood to be among the earliest points of decay.

YELLOW BIRCH, GRAY BIRCH.

(See Plates 1 and 2).

(*Betula lutea*, Michx., f.). (Sargent, *Silva N. A.*, Vol. IX, p. 53, t. 449).

This is an even larger tree than the black birch. During the past season I measured a specimen in Sullivan county which was ninety feet high and five feet in diameter. It was so old that the characteristic outer bark had peeled off, and it has simulated the black birch so much that it was regarded as belonging to that species. It was known among the woodsmen of the region as the "bastard birch." Wood is hard, heavy and strong, polishing well. Bark, yellow or gray, or a mixture of both. Epidermis and deeper-seated layer showing a marked tendency to peel off horizontally in large flakes, and then revealing a yellow or dark brown surface underneath. Leaves, often narrower toward base and not much inclined to be heart-shaped. Female cones an inch or less in length.

The yellow birch readily adapts itself to circumstances. Its seeds falling upon a decaying log or stump will germinate there and send the roots down to the soil beneath, thus making the many prop-like supports that the old tree shows after the stump or log has decayed. I saw in Sullivan county one instance where the tree has commenced its growth eight feet above the ground on a moss-covered rock, but had succeeded in sending its snake-like roots down to and into the ground. The yellow birch has not been in so great demand here as the black, hence it remains more abundant. In fact, it is, after sugar maple, probably the most abundant hard wood in the State to-day. It has a wide range of utility. It is a good fuel and is manufactured into furniture, hubs for wheels and small boxes for various purposes. It is also employed in the production of "wood acid." From troughs cut in the aerial roots, one may in springtime soon obtain enough of sweet sap to quench the thirst. The yellow birch grows from the Saint Lawrence to the peaks of North Carolina.

Physical properties, specific gravity, 0.6553; percentage of ash, 0.31; relative approximate fuel value, 0.6533; weight in pounds of a cubic foot of dry wood, 40.84; relative strength, 5.

It thus ranks next to the locust as the strongest of our Pennsylvania woods.

WHITE BIRCH.

(*Betula populifolia*, Ait.). (Sargent, *Silva N. A.*, Vol. IX, p. 55, t. 450).

An unimportant tree, found only in the cooler parts of the State, and then usually in damp and poor places. Seldom more than thirty feet high and a foot in diameter. Wood, soft, light and weak. Tree of rapid growth. Bark of stem a dead, chalky white color; the branches inclined to droop, purple or black, with roundish gray dots. Leaves, triangular, from a straight or somewhat heart-shaped base, tapering suddenly into a slender point, irregularly toothed; neither surface hairy, "sticky" when young, on slender footstalks, hence readily waved by the wind. Male flowers on ends of branches in hanging clusters from two to three inches long, brown or yellowish in color. Female flowers on the sides of the younger branches, at first slender, erect and green; when mature brown, drooping, an inch or more long and one-fourth as much in diameter, hanging from a footstalk which is a quarter, or a half inch long.

The white birch, though of small importance from the lumberman's standpoint, has its uses. Its chief value lies in the fact that it will grow rapidly on land which will not be likely to produce, at first, any other kind of timber. It is asserted by Connecticut observers that once they can get the white birch to grow, they can then succeed in having a more valuable timber grow among it. It seems, in other words, to be a nurse plant for a crop of better trees. As an aid to the landscape gardener, both the form and the color of the tree readily lend themselves. It makes a good, clean charcoal and fuel, is cut also for hoop poles. It is also manufactured into shoe pegs and wood pulp. Birch oil and also a decoction of the bark and leaves of the tree are popularly esteemed as remedies in vesical and rheumatic diseases.

The white birch grows from New Brunswick to Delaware along the coast and in the interior it is found in the higher mountain counties of Pennsylvania occasionally.

Physical properties, specific gravity, 0.5760; percentage of ash, 0.29; relative approximate fuel value, 0.5743; weight in pounds of a cubic foot of dry wood, 35.90; relative strength, 146.

CANOE BIRCH, PAPER BIRCH.

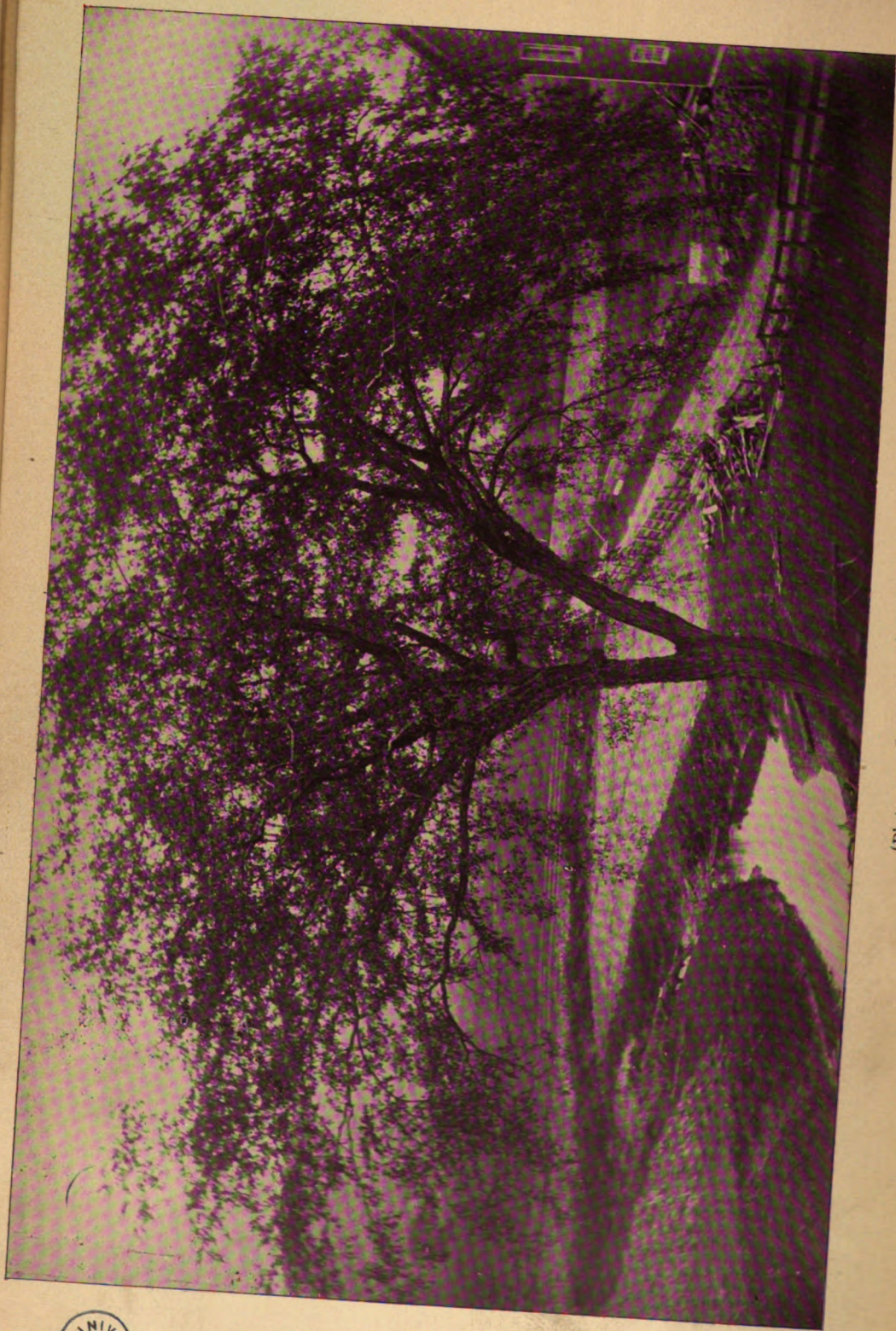
(*Betula papyrifera*, Marshall). (Sargent, *Silva N. A.*, Vol. IX, p. 57, t. 451).

A larger, better tree than the white birch just described. It grows from fifty to seventy feet high and has a diameter of from a foot to two feet and a half. Wood possesses many desirable qualities, light and strong, close grained and polishes well; that of heart brown, sap wood white. Bark of trunk on old trees dark, younger ones white, with elongated horizontal yellow strips where outer white bark has been removed; of branches olive green, or copper colored; branches with "grayish brown dots." Leaves, from two to four inches long and about half as wide, on footstalks from half an inch to an inch long, margins sharply doubly-toothed; upper surface smooth and green, lower surface pale and a little hairy on the veins. Male flowers in slender drooping clusters three or four inches long; female flowers mature into cylindrical hanging cones, or clusters, which are from an inch and a quarter to an inch and a half long, and less than half an inch in diameter; footstalks almost half an inch long.

This tree which has many good qualities and properties is chiefly valued and known as the canoe birch, because from it the Indians made their bark canoes. The bark is also used as a substitute for shingles and weatherboarding in the construction of temporary houses in the northern woods. From it also boxes and baskets may be made. Artists have also managed to utilize the bark as a basis on which to paint effective, cheap pictures. From the wood, spools, shoe lasts, pegs and wood pulp are made. It is also useful to the turner and makes good fuel. Emerson says that the wood of the paper birch when exposed to alternations of moisture decays readily, but if the tree is cut in summer and kept from the weather it becomes very durable. It has also, he says, a place in the manufacture of chairs and furniture.

Canoe birch ranges from high north to the colder parts of Pennsylvania and west to Minnesota.

Physical properties. specific gravity, 0.5955; percentage of ash, 0.25; relative approximate fuel value, 0.5940; weight in pounds of a cubic foot of dry wood, 37.11; relative strength, 38.



(Plate 33. See pages 177 and 269.)
Red or River Birch. Wyoming Valley.



RED BIRCH, RIVER BIRCH.

(See Plate 38).

(Betula nigra, L.). (Sargent, Silva N. A., Vol. IX, p. 61, t. 452).

From fifty to seventy feet high and occasionally three feet in diameter. Wood, light, but hard and strong, with red streaks, polishes well, not durable in exposed situations. Its tendency to split in the sun, Emerson says, may be obviated by water seasoning; durable when protected. Bark of trunk dark gray, rough, raised in shreds or flakes; that on the branches is distinctly red, or red and white, very rough and ragged; young shoots black or brown, somewhat hairy. The branches on large trees droop very much as those of the elm do, and a large, perfectly formed specimen of this species is almost as ornamental as an elm. Leaves, ovate, base without teeth, tapering suddenly to the footstalk which is about a quarter of an inch long; margin on upper three-fourths sharply, doubly-serrate, tapering to a point; whitish on under surface. Mature female flowers in hairy, scaly, cone-like heads, which are about an inch long and one-third as thick.

This birch will grow, when transplanted, in any soil that is not excessively dry and poor. Nevertheless it is found naturally only in damp places and on river banks. It grows very abundantly along the Susquehanna, but is less common on the Juniata. Almost always it is found leaning toward the water, because partly undermined by the current on that side. In Pennsylvania the wood is almost never used, though it makes good fuel and elsewhere is employed to make "furniture, wooden ware, wooden shoes and ox yokes," according to Professor Sargent.

Physical properties, specific gravity, 0.5762; percentage of ash, 0.35; relative approximate fuel value, 0.5742; weight in pounds of a cubic foot of dry wood, 35.91; relative strength, 69.

SMOOTH ALDER.

(Alnus serrulata, Willd.).

With us a shrub rather than a tree. May reach thirty feet in height, but is seldom more than twenty feet high. Heart wood brown, or reddish-brown in color. Bark, dark brown, sometimes almost black, not much roughened. Leaves, ovate, tapering grad-

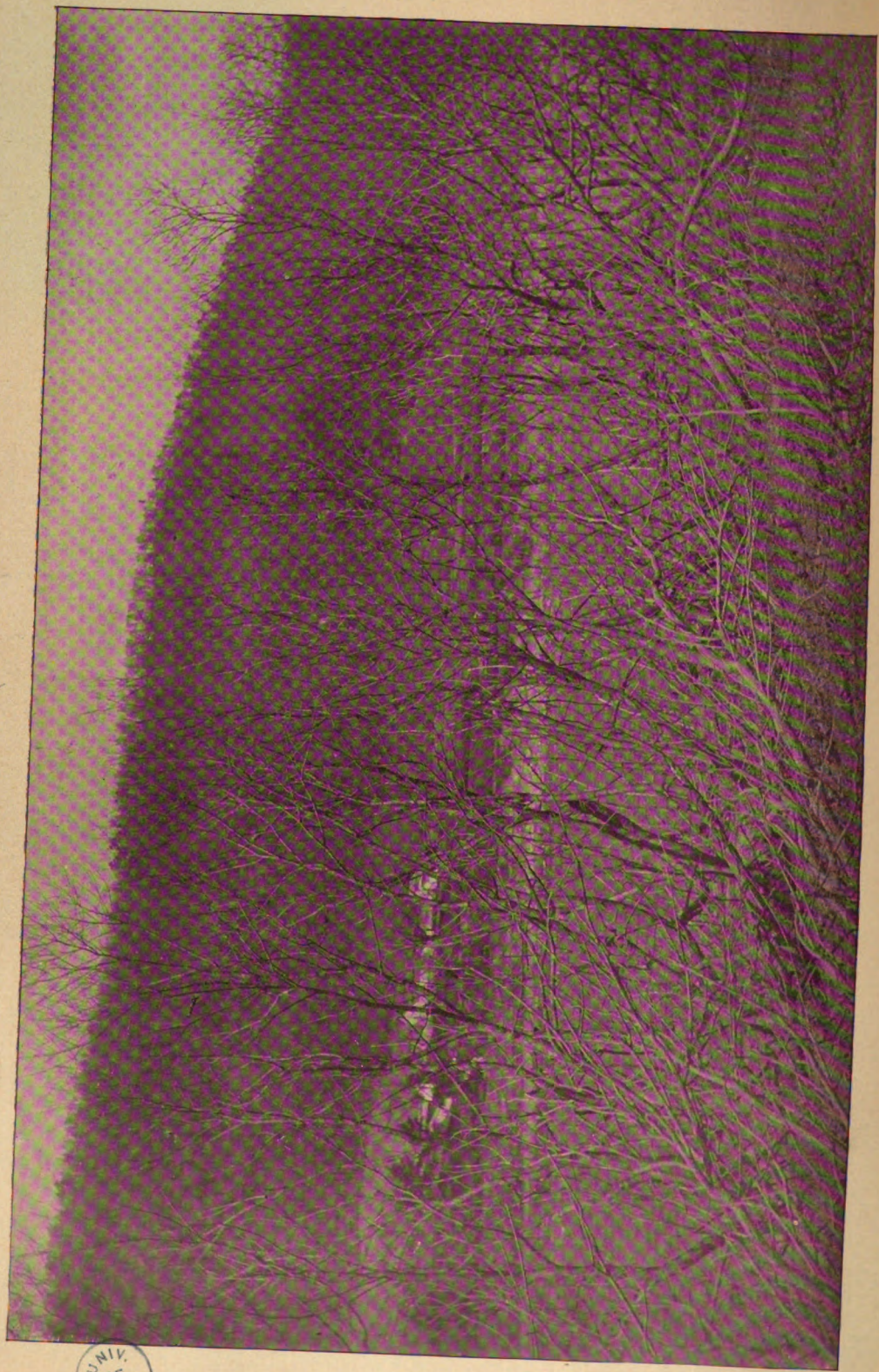
ually to a base, apex pointed, margin with small teeth, except the portion near the base, rather thick, green on both sides; appearing later than the flowers. Male flowers in clusters three inches long, of which from three to five arise together; each cluster scaly, drooping, in color red and yellow. Female flowers erect, ovate or oblong, purple, with thread-like hairy styles projecting. Mature seed vessels half an inch or less in length, hard, woody, becoming black, and remaining on the branches all winter.

The alder is the most common bush along our streams and forming its flowers the autumn before, appears in bloom on the first sign of spring, before the leaves come out. Its branches have usually a broken, kinky appearance. It is not possible to say that thus far (here) any use for it has been found. Nevertheless, it is pretty sure to be valued in future, because it is among the very best of our native shrubs to hold soil, on the edge of a stream, against the action of the water. Furthermore, it will grow luxuriantly on soil which is too cold, wet and poor to produce any more valuable wood. Emerson, in his report on the trees and shrubs of Massachusetts, says that it makes good fuel, and produces a quality of charcoal better suited than any other for the manufacture of gunpowder, and that it is used for hoops of small casks. In Europe the bark of a related species is utilized by the tanner. The leaves and bark in the form of a decoction are also used here as an astringent remedy in diarrhoea and bloody fluxes. This, of course, is due to the tannin they contain.

Physical properties, specific gravity, 0.4666; percentage of ash, 0.38; relative approximate fuel value, 0.4648; weight in pounds of a cubic foot of dry wood, 29.08.

GENERAL PRELIMINARY STATEMENT CONCERNING THE WILLOWS.

Under the head of the willow family are grouped shrubs and trees, whose flowering and reproductive organs are reduced to an extreme degree of simplicity. Not only are the conspicuous organs which we designate flowers in popular language wanting, but the sexes are separated so completely that one tree or shrub is wholly male or wholly female, and two individual trees or shrubs are required to complete the idea of a perfect species. It should be said here in general terms that we have never sufficiently appreciated the value of our willows as offering protection against the action of



(Plate 34. See pages 184 and 271.)
Black Willow, by Juniata River, Gathering Soil.



water. I have now in mind a place in Mifflin county where an island (Mattawauna) was being worn away by the annual floods until the owner could with a moderate degree of certainty have estimated how long it would be before his fertile farm would have practically disappeared. He began a few years ago to plant willows (*Salix nigra*) on the belt of land between the face of the bank, marking ordinary high water limits, and the low water mark. To-day he can see the willows spreading, and can note the soil being deposited around them which clearly indicates that not only has the destructive process been arrested, but that the process of repair has commenced.

There are few species of willow which merit special attention here, but among them is:

BLACK WILLOW.

(See Plate 34.)

(*Salix nigra*, Marshall). (Sargent, *Silva N. A.*, Vol. IX, p. 103, t. 462, 463).

Low tree, seldom with us more than thirty feet high, or than fifteen inches in diameter. A very common shrub or tree along river and stream banks, and also very variable. Wood, of no special value. Bark, dark and rough on main stem, somewhat hairy on the younger branches. Leaves, narrowly lance-shape, two or three inches long, sometimes downy, but ordinarily smooth and green on both surfaces, tapering to a point at each end; footstalk not more than a quarter of an inch long. Flowers appear in May at same time as the leaves. Males in slender yellowish clusters which are from one and a half to two inches long; females in clusters of from two to three inches in length. In one variety the leaves are from three to six inches long and are somewhat curved, "sickle fashion." There is practically no use made of this wood. The bark was, before the introduction of cinchona, much in demand as a remedy for fever of a malarial origin. Salicylic acid, now so much used in rheumatic troubles, is another product of this and other kinds of willow.

Physical properties, specific gravity, 0.4456; percentage of ash, 0.70; relative approximate fuel value, 0.4425; weight in pounds of a cubic foot of dry wood, 27.77; relative strength, 297.

Among the weakest of our woods.

The willow has the scales on the flower clusters neither toothed nor fringed, the flowers have small glands. Stamens are few and there is but one scale to the bud whereas in *Populus*, which follows, the stamens are numerous and the flower scales are variously cut or fringed.

ASPEN, QUAKING ASP.

(*Populus tremuloides*, Michx.). (Sargent, *Silva N. A.*, Vol. IX, p. 158, t. 487).

Tree is from thirty to forty-five feet high, and a foot, or a foot and a half in diameter. Wood is light and soft, of no great use where strength or durability are required. Bark of stem is smooth, or rough in spots, which are quite dark, elsewhere the color of the trunk is a dead white, with just a greenish tinge. Branches drab colored, especially on the lower side. Leaves roundish from a very slightly heart-shaped base, tapering somewhat abruptly to a point, more or less toothed all around margin except on the base; upper and lower surfaces smooth; footstalks from one to three inches long; expanded vertically so as to be very thin, which allows the slightest breeze to put the leaves in motion. The flower cluster scales are cleft or divided, the flower has a broad cup-like disk, there are many stamens and several glutinous scales to the buds. Flowers appear in April before the leaves, in long, drooping, scaly clusters. Seeds "with a silky or cottony crown;" male flowers have stamens of a bright red color.

The quaking aspen grows best in cold situations and so far as my observation goes, on a clay soil. It attracts the pheasants in wooded regions, to feed upon its buds during the winter when the snow has covered and concealed all other sources of food supply. Owing to the rapidity with which the quaking aspen grows, it might serve as a nurse plant to shade other more important kinds of young trees which would be injured by the intensity of the sun's glare. In fact, it does naturally do so on the fire-swept Rocky mountain surfaces, and prepares the way for something better. The quaking aspen is used to a considerable extent in making pulp and excelsior. In common with other related "poplars," the bark contains salicin, which is employed as a remedy, more formerly than now, in treatment of malarial fever. Used on the Pacific coast, to a limited extent, in flooring and as a wood for turners.

This tree is said by Professor Sargent to grow over a wider geographical area in North America than any other tree. Thus, from Newfoundland to Alaska, south to Chester county in this State, thence west through Kentucky, through Arizona and New Mexico and Arizona to California.

Physical properties, specific gravity, 0.4032; percentage of ash, 0.55; relative approximate fuel value, 0.4010; weight in pounds of a cubic foot of dry wood, 25.13; relative strength, 205.

POPLAR, LARGE-TOOTHED ASPEN.

(*Populus grandidentata*, Michx.). (Sargent, Silva N. A., Vol. IX, p. 161, t. 488).

From thirty to forty feet high, growing higher in states to the north of us, erect, not very broad-topped; almost a foot in diameter, but seldom exceeding this in this State. Wood, weak and light, of no great value. Bark, greenish gray, smooth, except in very old trees, branches darker colored, buds conical in shape. Leaves, large, three to five inches in diameter, almost round, deeply toothed, sometimes almost lobed, when young, covered with soft white down, becoming smooth or hairless with age; footstalks two to three inches long, flat, seed clusters also two or three inches long. Not common. Wood, once used in the manufacture of hats, and high heels for shoes. Makes, according to Emerson, a fairly good fuel. Used for pulp, turnery and wooden ware. Grows best in wet grounds, and found from Nova Scotia south, on the mountains, to North Carolina and west to Tennessee and Kentucky.

Physical properties, specific gravity, 0.4632; percentage of ash, 0.45; relative approximate fuel value, 0.4611; weight in pounds of a cubic foot of dry wood, 28.87; relative strength, 178.

RIVER COTTONWOOD, SWAMP COTTONWOOD.

(*Populus heterophylla*, L.). (Sargent, Silva N. A., Vol. IX, p. 163, t. 489).

Thirty to fifty feet high in Pennsylvania. Bark, grayish brown. Leaves, variable in size, three to six inches long and about as wide, on round, not flat, footstalks from two to five inches in length (foot-

stalks and leaves at first covered with a brownish down, afterwards becoming smooth). Leaves rather thick, evenly but not deeply toothed; heart-shaped at base, with lobes often over-lapping so as to conceal the insertion of the footstalks. Too scarce and wood too poor to have any great commercial value.

Physical properties, specific gravity, 0.4089; percentage of ash, 0.81; relative approximate fuel value, 0.4056; weight in pounds of a cubic foot of dry wood, 25.48; relative strength, 225.

COTTONWOOD, NECKLACE POPLAR, CAROLINA POPLAR.

(*Populus monilifera*, Ait.). (Sargent, Silva N. A., Vol. IX, *Populus deltoidea*, p. 179, t. 494, 495).

Large tree. Bark of trunk dark gray, or "granite colored," deeply and roughly fissured, with light yellow lines here and there visible in the depths of the fissures. Branches in the second and third years smooth, light gray, or with a slight tinge of yellow, abundantly sprinkled with oblong spots (lenticels) one-sixteenth to one-fourth of an inch long; pith light brown, surrounded (in freshly cut stem) with a ring of pale green (chlorophyll). Yearling shoots, sometimes more or less angled (varying on same tree from round to decidedly angled), light yellow or orange-colored, smooth, glistening, with many small lenticels which are from one-sixteenth to one-eighth of an inch long, when freshly cut showing a distinct, green chlorophyll ring around the pith. Buds green, slightly covered with gum or balsam. Leafstalks flattened, smooth, usually slightly longer than the leaves.

Leaves usually somewhat triangular in outline; varying much in size, from three to eight inches in length and sometimes a little broader than long; straight, or slightly rounded, or slightly heart-shaped at base, which is but little toothed. There are generally two small glands on upper surface of leaf, i. e., one on either side of insertion of footstalk; margins of leaf with rounded incurved teeth which point toward the tapering leaf tip, each tooth ending in a minute brown gland. Lower surface of the leaf at first slightly hairy, later almost wholly smooth, but always lighter in color than the shining dark green upper surface.

Male and female flowers on different trees, but each kind arising from near the ends of the young branches, in drooping clusters from two to four inches in length and from one-fourth to one-half of an

inch in thickness. The female clusters elongate in maturing and sometimes attain a length of one foot. The seed vessels are thus separated, and each one is on a slender stalk from one-eighth to one-fourth of an inch in length.

The Carolina poplar is a tree of very rapid growth and hence has become too common on our sidewalks and in our public squares. It grows readily from cuttings. Emerson has called attention to the fact that the male trees are more desirable for planting near dwellings than the females, which produce enough of "cottony seed" to become a serious nuisance. The timber is desirable when dry, but lacks strength required for general purposes. It is besides liable to warp and split. Hence its chief value is in production of wood pulp.

It is not a common tree in this State. It ranges from Lake Champlain to Florida and west to the Rocky mountains. Physical properties are, specific gravity, 0.3889; percentage of ash, 0.96; weight in pounds of a cubic foot of dry wood, 24.24.

The white poplar (*Populus alba*, L.) has been introduced here from abroad. It has become, in places, a weed from its tendency to multiply by shoots from roots. Unless it becomes of value in production of wood pulp, it had better be exterminated.

EVERGREEN, OR CONE BEARING TREES.*

Have a fruit made up of a set of scales arranged in a cone, or a more or less round and fleshy body, and with the naked seed (or what is to become seed) under each scale or in the fleshy cup. The trees have usually a resinous juice. The leaves are very slender or small. In Pennsylvania we have pines, spruces, hemlock, fir, larch and arbor vitae, which attain full tree size. These groups are variously characterized.

Thus the pines all have long, slender, needle-like leaves, which arise in clusters of two, three or five from a given point, and when all the leaves of a cluster are placed together they form a round thread-like body. Where there are two leaves in a cluster a cross-section of each leaf would be half of the circle. Where the leaves were three in a cluster, each leaf in cross-section would represent one-third of the circle; one of a five-leaved cluster would give a cross-section of one-fifth of a circle. Under each scale of the cones (which require two seasons to mature) are two winged seeds, partly sunk in the cone scale. Male flowers are in cylindrical yellow or brownish clusters, and produce a great quantity of yellow

*The term evergreen is not strictly correct because one of the trees, certainly, growing naturally within our limits, the larch, bears cones and also sheds its leaves before the new leaves appear. The bald cypress does the same, but I have never seen it growing naturally within our limits.

powder (pollen or the male, fertilizing material). This pollen is the substance out of which the alleged sulphur showers are invariably produced. Being light, it may be, and is often, carried by the winds for hundreds of miles from where it was formed.

WHITE PINE.*

(See Plate 35).

(*Pinus Strobus*, L.).

Tree often more than one hundred feet high, and sometimes reaching a diameter of six feet. Wood, soft, light, moderately strong, easily worked, and fairly durable. Bark, smooth, reddish-green; on old trunks dark, considerably cleft. The branchlets are soft, flexible and come off about five together around the parent branch, but all tending to point upwards. Leaves, grayish green, slender, five in a cluster and from three to six inches long, gathered mainly at the end of the branches, those of the earlier years having fallen off. The pines are evergreen not because they never shed their leaves, but because they form the new ones before they drop the old. Cones, when mature, from four to seven inches long and from one inch to one inch and a half in diameter, green when young and with scales closed during the first year, brown when matured and scales open at the end of the second year.

The white pine of our State is practically an exterminated tree; that is, there now remains so little of it standing of mature growth, that in a very few years it will, if existing conditions continue, cease to be a tree of any commercial importance. This is not because there is no tendency to a spontaneous reproduction, but, because owing to our criminal neglect, forest fires are allowed year after year to sweep over and destroy the young trees. When a few years hence we begin to feel the pressure arising from want of employment to men, and want of material from lumber produced, we will recognize how serious a blunder we have been guilty of, and how short-sighted our policy has been. The relation of white pine to the discovery of America, if we were in possession of all the facts, would probably be found to be a surprising one. Thus, it is becoming more and more probable to those who have examined into the question that the Northmen were on this coast centuries before Columbus. If this be true, we may well suppose that the fine timber which it is alleged they carried with them on their return from Newfoundland

*Further citations from Sargent's *Silva* are impossible as the work is only completed to this point.

and sold in Bremen was the white pine. It is hard to think it could have been anything else when all the conditions of the question are inquired into. All white pine lumber is good, though there is some of better quality than the rest. The cork and pumpkin pines of early days were light, straight grained, soft and often of a more or less golden color. It represented the best production of the forest, and came from trees which were well matured, and had grown in clumps so dense that as it developed, the lower limbs fell away early and so left small inconspicuous knots behind them. It was also spoken of as the clear stuff. The white pine ranges from Newfoundland and the Gulf of Saint Lawrence, south along the mountains to northern Georgia, and from Pennsylvania west to "southern shores of Lake Michigan." It generally prefers a poor soil, though in this State it may be found growing from the rich alluvial flats to the mountain tops, in regions where it is indigenous. The white or light brown wood is used for shingles, weatherboarding and for interior finish to houses. When simply treated to a coat of shell-lac, it gives a soft, pleasant effect. It is manufactured into window sash and doors, and is used for manufacture of paper pulp.

Physical properties, specific gravity, 0.3854; percentage of ash, 0.19; relative approximate fuel value, 0.3847; weight in pounds of a cubic foot of dry wood, 24.02; relative strength, 232.

PITCH PINE, YELLOW PINE, JACK PINE.

(See Plate 4).

(*Pinus rigida*, Miller).

A rugged, hardy tree from forty to ninety feet high and ordinarily about a foot in diameter, though sometimes three feet through. Wood, rather hard and strong, very resinous, a light brown or yellow color at heart; sap wood yellow, greenish, or often almost white. Bark of trunk red, rough and inclined to separate in thin flakes; that of branches brown, more or less ringed around, or scaly from the descending sheaths of the leaves; branchlets tending to come off around the branches in threes. Leaves, in threes, from three to five inches long, rather hard, dark green. Cluster of male flowers from half an inch to an inch long, appearing in May. Cones at end of first year, less than half an inch long, one or two together. During the second year they ordinarily grow to maturity and are then from two to three inches long, with the tips of the scales thickened and ending in a weak prickle an eighth of an inch long which is usually recurved. Sometimes maturity of the cones is postponed until the

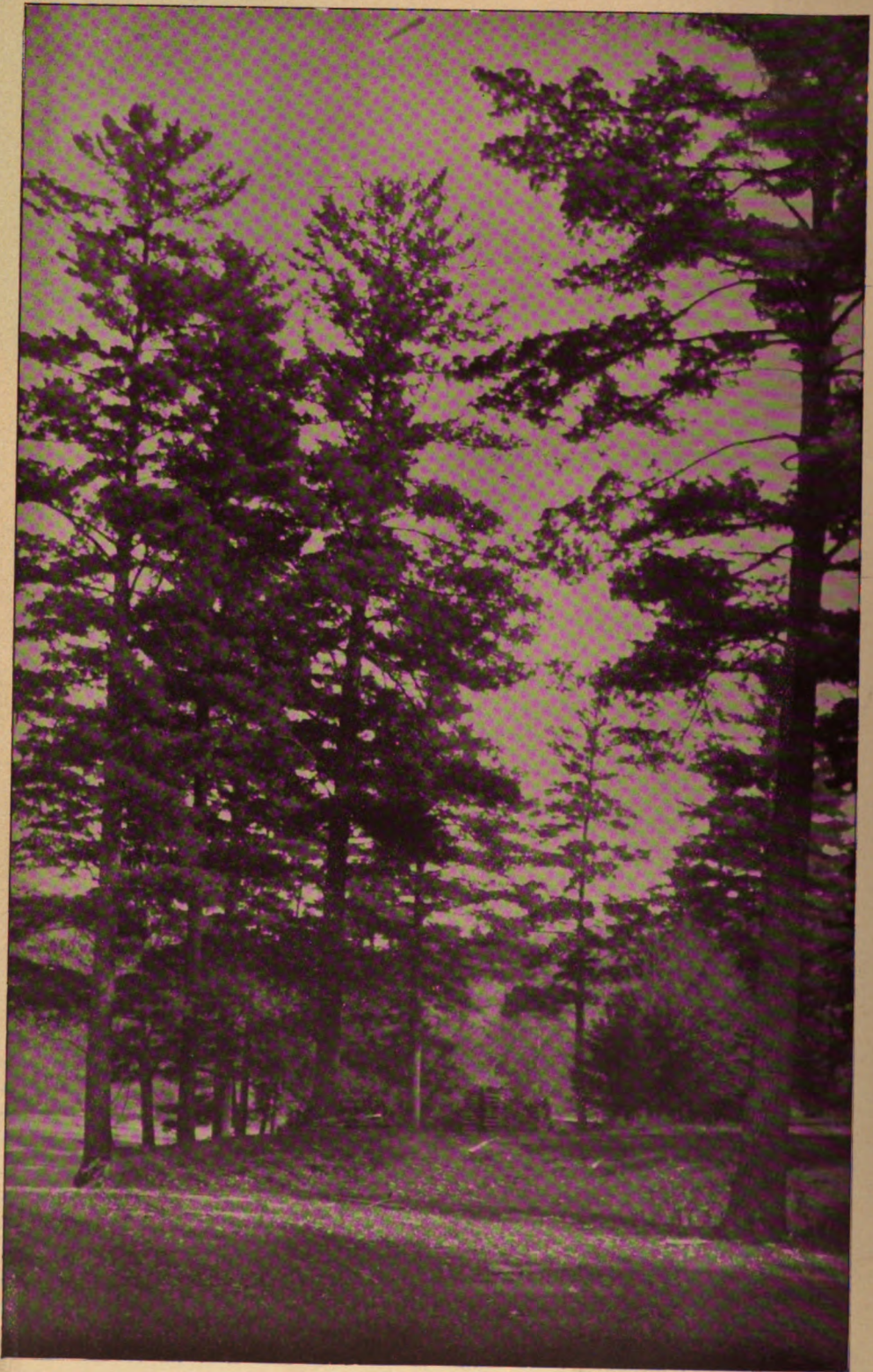
third year. It is generally stated that no cone-bearing tree of our region will sprout from the stump. This, however, is not true. If the stump of a pitch pine is burned slightly before it dies, it very frequently sends out short, soft sprouts which are covered with a multitude of imperfectly formed, pale, leaves, about an inch and a half long. I have never known these sprouts, however, to survive longer than a year in this State. The barrens of New Jersey present the singular and unique anomaly of pitch pine sprouts growing to a height of twenty feet or more.

The pitch pine is a most valuable tree. Two forms are recognized by our lumbermen; one which they call yellow pine is the form I have just described. I should add that in this the zone of sap wood is narrow and the heart wood is solid, with well defined annual rings. It is regarded as a fairly good wood.

The other form has a dark, ragged bark, somewhat gnarled limbs and a zone of sap wood which is so wide that it greatly impairs the quality of the log as a lumber. This is the jack pine of the lumberman.

Pitch pine is now a most important tree in some portions of the State where the white pine and the hemlock have been removed. Its chief use is as mine props, though good sticks of it are sawed into boards, etc. It makes a good charcoal, and has the great merit of withstanding the severe scorplings of forest fires, after being four or five inches in diameter; though it should be known that such burnings diminish the yearly growth of the tree. It should be added that in Central Pennsylvania the pitch pine grows to a large size and is in great demand for barn frames. In the ground the pitch pine lasts a long time, especially the "knots" and other parts that contain turpentine in large quantities. This tree shows a wonderful adaptability to varied conditions of soil and exposure. It seems to thrive on thin soil, whether it is the sand of the seaside, or the gravel flanks of our ridges and mountains, and, indeed, will grow where almost no other tree will. It is usually of very slow growth. I have measured logs fourteen inches across, which were one hundred and twenty years old, as indicated by the annual rings. Emerson states that the pitch pine makes a good lower deck and beam timber for ships, and that is very suitable wood for ship pumps. [Let me add of the old style]. It makes an ornamental finish for rooms, if care is taken in selection of the wood.

Physical properties, specific gravity, 0.5151; percentage of ash, 0.23; relative approximate fuel value, 0.5139; weight in pounds of a cubic foot of dry wood, 32.10; relative strength, 168.



(Plate 35. See pages 184 and 276.)

White Pine, along Delaware River, Wayne County.





(Plate 36. See pages 187 and 281.)

Red Pine. Hyner's Run, Clinton County.



POVERTY PINE, TABLE MOUNTAIN PINE, PRICKLY PINE.

(*Pinus pungens*, Michx., f.).

From twenty to fifty feet high. In general appearance much like the pitch pine except that its leaves are usually in twos instead of threes, rather thick, about two inches long. The cones, about three inches long and two inches in diameter, are arranged in clusters around the branches. They remain on for several years, and the scales are tipped with a strong prickly which is from a quarter to a half an inch long. The prickly pine makes a fair fuel and charcoal. I am not aware, however, that it is used for any construction work.

The history of the tree is a somewhat singular one. Michaux speaks positively of it as growing only on Table mountain in North Carolina, and he predicts its early extinction. (See North American Sylva). About 1864 it was discovered in Eastern Pennsylvania by Professors Porter and Meehan. A year or two later Professor Asa Gray and I discovered it in Mifflin county of this State. Last season I found it in Fulton county, growing in very poor soil, and hence its name there, poverty pine. I also found it in making up the bulk of the timber in certain slaty ridges in Union county. It is certainly not much of a tribute to the observing faculties of some of our woodsmen to say that though they have been working among it for years, they have not generally detected how much it differs from the pitch pine. In fact, the majority of them call it by that name.

Physical properties, specific gravity, 0.4935; percentage of ash, 0.27; relative approximate fuel value, 0.4922; weight in pounds of a cubic foot of dry wood, 30.75; relative strength, 174.

JERSEY PINE, SCRUB PINE, JERSEY SCRUB PINE.

(*Pinus inops*, Ait.).

A low tree, seldom exceeding forty feet high in this State. Bark, dark, much cracked. Branches angular in their bending, whole appearance of the tree uninviting. Leaves, ordinarily in twos, sometimes in three, from one and a half to three inches long, rather weak. Cones resembling those of the pitch pine, except that they are somewhat smaller, about two to two and a half inches long, and

when closed, hardly half as thick; the slightly thickened tips of the scales have a short weak prickle. The young branches have a purple or a blue purple color, which will serve to distinguish it from any other species of pine in our region.

This species grows in Kentucky and Indiana to a much larger tree than with us. Its chief use is for fuel, charcoal and occasionally in making pump-stocks. It is found growing naturally from Long Island to South Carolina and in Pennsylvania about two hundred miles inland.

Physical properties, specific gravity, 0.5309; percentage of ash, 0.30; relative approximate fuel value, 0.5293; weight in pounds of a cubic foot of dry wood, 33.09; relative strength, 214.

SPRUCE PINE, YELLOW PINE.

(*Pinus mitis*, Michx.).

This tree illustrates the evil of the so-called "common names," it and the pitch pine both being called yellow pine. Fortunately, so far as that goes, the spruce pine as we shall call this has become exceedingly rare in this State. Professor Porter reports it from Huntingdon and Lancaster counties. In its best condition it is a larger tree than either of the other pines described. The leaves, usually in twos (sometimes in threes), are more slender than any of our other pines, except the white pine, and are from three to five inches long. The cones vary in size, but ordinarily are oblong and less than two inches in length, and the cone scales are tipped with a short, weak, recurved prickle. Michaux, in *North American Sylva*, asserts that the cones mature and shed their seeds in the first year.

The wood is strong, and if properly seasoned, durable. Heart wood. Professor Sargent describes as orange colored, that of sap nearly white. He adds, "largely manufactured into lumber, and among the yellow pines only inferior to *Pinus palustris*," which is here commonly called Georgia pine. It once grew somewhat commonly in New Jersey, but is now mainly confined to the southern regions and to the lower Mississippi Valley.

Physical properties, specific gravity, 0.6104; percentage of ash, 0.29; relative approximate fuel value, 0.6086; weight in pounds of a cubic foot of dry wood, 38.04; relative strength, 48.

NORWAY PINE, RED PINE.

(See Plates 26 and 27).

(*Pinus resinosa*, Ait.).

A handsome tree growing in the cooler parts of the State, to a height of at least a hundred feet, with a diameter of more than two feet. Wood is light, and said to be lacking in strength (upon which point, however, practical men differ), that of heart is reddish, that of sap white or yellow. Bark, even on old trees, is reddish and smoother than that of the pitch pine, with which it grows and to which it bears a general resemblance, except that its stem is tall and straight and its branches less curved than those of the pitch pine. Leaves in pairs from four to six or even seven inches long, and having a tuft-like appearance on the ends of the branches. The cones are about two inches long, or sometimes a little more; the scales only a little swollen at the tips and without prickles; green during the first season, reddish-brown or black at the end of the second.

To me, a perfectly shaped vigorous red pine is among the most beautiful of our trees. In Pennsylvania I have found it growing most commonly and luxuriantly on the rocky slopes of Hyner's Run, in Clinton county. It is by no means common anywhere in the State, and can hardly be said to figure in any lumbering industries. In general, it is simply used here as a substitute for pitch pine.

The red pine ranges from the Gulf of Saint Lawrence to Central Pennsylvania and thence westward to Michigan and Minnesota.

Physical properties, specific gravity, 0.4854; percentage of ash, 0.27; relative approximate fuel value, 0.4841; weight in pounds of a cubic foot of dry wood, 30.25; relative strength, 136.

Spruces, hemlocks and firs all differ from the pines in having a short, more or less flat and short leaf arising from a given point, instead of having longer leaves in clusters of two or more. Their cones mature in a single year, and the scales never thicken on the outer end.

RED SPRUCE.

(*Picea nigra*, Link, var. *rubra*, Engelm.). (Sargent, Silva N. A.,
Picea rubra, Link).

A straight tree tapering gracefully to a height of a hundred feet, or more; and said to have an occasional diameter of more than three

feet. Heart wood slightly red. Bark light gray to dark gray or brown, more or less covered with partly detached scaly flakes. "Leaves are dark green and lustrous; branchlets stout. Cones often two and a half inches long and straight at the base; usually falling during the first winter."

Tree furnishing a light, fairly strong and elastic lumber, much esteemed for smaller ship's spars and for making "wood pulp." It prefers the highest ridges in the State and is found growing on the head waters of the Mehoopany creek in Wyoming county. A fine body of splendid specimens stood (until recently exterminated) in Bear Meadows in Centre county.

BLACK SPRUCE.

(*Picea nigra*, Link). (Sargent, Silva N. A., *Picea nigra*, Link).

A much smaller and usually more "scrubby" tree than the red spruce, with which it has been generally confounded by American botanists until clearly distinguished and characterized by Professor Sargent (to whom I am indebted for the diagnostic points). It prefers "sphagnum-covered swamps. Leaves are bluish green; branchlets slender; cones about an inch long, broadly ovate and prominently incurved at the base, sometimes remaining on the tree for ten or twelve years." In all respects, probably, a less valuable tree than the red spruce. It is found in Pike county in the colder swamps associated with and supplanting the white pine. It is also probably found in Tamarack Swamp in Clinton county.

HEMLOCK, HEMLOCK-SPRUCE.

(See Plates 31 and 38).

(*Tsuga Canadensis*, Carr.).

One of our largest and most valuable trees. Height from sixty to one hundred feet and diameter from two to four and a half feet. A tree of this maximum diameter is usually almost five hundred years old. Wood is weak, hard to work and liable to split, but nevertheless largely used in construction purposes. Bark, dark brown ex-



(Plate 37. See pages 187 and 281.)

Trunk of Red Pine. Hyner's Run, Clinton County.





(Plate 38. See pages 188 and 282.)

Hemlock Past its Prime, Probably 500 Years Old. Ganoga Lake, Sullivan County.

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ternally, red internally and very rough on old trunks; that on the young branches is light gray and smooth. Leaves, about half an inch long, flat, gray on under surface, green above and apparently arranged on the sides (not on upper or lower surfaces) of the branches. Young cones are, on the ends of the small branches about a quarter of an inch long and green. The ripe cones are egg-shaped, from half to three-quarters of an inch long and drooping from a little footstalk.

No tree of our forests is more graceful or beautiful than a young hemlock. Its bark is smooth, its foliage is light and airy, despite density, and every tip of its branches hangs in a gentle curve. It suggests strength, pliancy and exuberant vitality. An old hemlock is rough, gnarled, and by the almost universal death of its top suggests an unsightly decrepitude. Whatever idea of strength it conveys is simply by its mass. It lacks the majesty of the oak and the grace of the adult elm. The only thing about it that inspires admiration or veneration is its age. When, however, we leave the aesthetic element out of sight, its great usefulness compels our respect. Of all our native trees it is the one species whose reproduction will be slowest and attended with the greatest difficulties, because the conditions of soil under which it flourishes are usually changed by its removal.

The hemlock grows naturally from Nova Scotia south along the mountains of Alabama, and west to Michigan and Wisconsin. Lumbermen recognize two varieties, the red and the white, of which the latter is considered the better. The distinctions, however, are by no means clear, either in the living tree or in the lumber. The annual value of the hemlock bark alone to the Commonwealth is now hardly less than fifteen millions of dollars. It is safe to say that the hemlock forests will have practically disappeared from our State in from twelve to fifteen years, under present rate of removal, and thus far there appears to be nothing to take its place. The wood is sold so cheaply that it could not be marketed to advantage were it not for the additional revenue that is derived from the bark. It is used for the rough inner work for houses and to a limited extent for railroad ties, though it is not durable in contact with the soil and crushes readily under the weight of heavy trains. The bark yields the tannin which is essential to the work of the tanner. It also for the same reason furnishes the physician an active astringent, and the resin forms the basis of numerous stimulating plasters. Woodmen drink a tea prepared from the leaves with the idea that it purifies the blood.

Physical properties, specific gravity, 0.4239; percentage of ash, 0.46; relative approximate fuel value, 0.4220; weight in pounds of a cubic foot of dry wood, 26.42; relative strength, 171.

BALSAM FIR, BALM OF GILEAD FIR.

(*Abies balsamea*, Miller).

With us this is an unimportant, scarce, small-sized tree, confined naturally to a few of the coldest parts of the State. Its average height is not more than forty or fifty feet, and its diameter about one foot. The yellowish wood is of almost no value. Bark, smooth, except in old trunks, with many vesicles or raised "blisters," which on being punctured yield a few drops each of a beautiful transparent balsam. Leaves flat, much resembling those of hemlock, giving off, when dried or drying, a delightful odor; about half an inch long, white on under surface and green above. Sterile flowers are from lower side of ends of the branches and rising out of a "cup-like irregular scale" from the upper side of the base of the leaf. Cones, when mature, are erect, from two to four inches long, about an inch thick, somewhat tapering and contain two seeds on the inner surface of the base of each purple scale. When the balsam fir grows "in the woods" in its best condition, it is a fine symmetrical tree which may be distinguished at a distance among its cone-bearing associates by its delicate spire-like top. This, however, seldom occurs in this State, where it is, usually, an unhealthy, short-lived tree. Its growth is quicker than that of most of its associates. I have found it in Pike and Clinton counties, and it doubtless grows elsewhere also. Naturally it grows from Labrador to the mountains of this State, and thence along the Allegheny summits to the mountains of Virginia.

Physical properties, specific gravity, 0.3819; percentage of ash, 0.45; relative approximate fuel value, 0.3802; weight in pounds of a cubic foot of dry wood, 23.80; relative strength, 274.

LAROH, TAMARAOK, HACKMATAOK.

(*Larix Americana*, Michx.).

A very rare tree in this State and found only in the colder, higher swampy parts; seldom grows to a height of more than fifty feet, and a foot or fourteen inches in diameter. Wood, hard, strong and durable; sap wood white, that of heart a delicate brown. Bark, blue-gray, rough and covered with small round scales. The younger

branches are tinged with red. Leaves deciduous, appearing in spring in bright green clusters from knot-like buds on the sides of the young branches. These are soft in texture, bright green at first and before falling in autumn become a pale yellow color. Male flowers are one-fourth of an inch in diameter, yellowish and near the ends of the branches. The cones are, in May, bright crimson, on the sides of the branches; when matured egg-shaped, about half an inch long, composed of a few scales, and brown.

The larch is among the most valuable of our American woods, for certain purposes. As a timber for ships knees, no wood surpasses it in value, unless it be the live oak. It is also valuable for posts, telegraph poles, ship timbers and railroad ties. Emerson speaks of its relative incombustibility and suggests that for this reason it would be valuable in construction of buildings designed to be fire proof.

Physical properties, specific gravity, 0.6236; percentage of ash, 0.33; relative approximate fuel value, 0.6215; weight in pounds of a cubic foot of dry wood, 38.86; relative strength, 94.

ARBOR VITAE.

(*Thuja occidentalis*, L.).

This tree is also one of colder climates and therefore found only in the higher parts of Pennsylvania. Here it seldom grows more than forty feet high, or has a diameter of more than one foot. The wood is not very valuable, being light and weak. Bark is brown, much divided by shallow clefts into many parallel narrow ridges, inclined to separate into elongated thin strips, so that it suggests the idea of "stringiness." The tree rises from a broad expanded base, tapers abruptly into a narrow, somewhat ridged trunk, then ascends to a very slender spire-like top. It usually begins to branch very low down. In open places its branches begin at the ground and expand so much as to destroy, to a great degree, the graceful, tapering summit. The branchlets are arranged as if they had grown on a flat surface, i. e., in a single fan-like plane. The surface of these branchlets is covered with flat, adherent scales or leaves on the back of which a small gland is seen; besides these one finds shorter leaves apparently surrounding the youngest branches on all sides. These leaves turn during the winter to a beautiful bronze color. The male flowers are very small, appearing in May on the ends of the branches, in clusters,

less than an eighth of an inch long. The cones are brown, of a few (six to twelve) more or less pointed scales (each something more than a quarter of an inch long), attached by the base only and on the inner surface of which there are two small seeds.

With us the arbor vitae is very common as an introduced tree. It well deserves a place on our lawns, and it makes a very good ornamental hedge. The chief value of the wood is in its durability under exposure, hence it is used for shingles, fences and railroad ties, but its soft character prevents its long withstanding the crushing weight of heavy trains. The Maine woodsman, Thoreau says, will

"Drink a quart of Arbor vitae
To make him strong and mighty."

This tree grows naturally from the Gulf of Saint Lawrence to Pennsylvania and thence south along the mountains to North Carolina, a very large specimen of it being found in Virginia at the Natural Bridge. It is however exceedingly rare in Pennsylvania.

Physical properties, specific gravity, 0.3164; percentage of ash, 0.37; relative approximate fuel value, 0.3152; weight in pounds of a cubic foot of dry wood, 19.72; relative strength, 275.

CEDAR, RED CEDAR, SAVIN.

(*Juniperus Virginiana*, L.).

A common tree in Pennsylvania, seldom more than thirty or forty feet high, or over eighteen inches in diameter. Indeed, these are exceptional. The tree is more frequently under than over thirty feet high. Wood is good and in great demand for its durability. The trunk is usually rendered unsightly by the gaps left where branches have fallen, or been removed. Bark, light or brown, somewhat stringy in appearance and seldom very deeply cleft or divided, red within. Leaves, much like those of the arbor vitae except that these (cedar) are smaller. The scales on the branches are sharp-pointed for an eighth of an inch then flatten out and descend for a quarter of an inch on the branches, each over-lapping the younger one. On the smallest side branches the leaves are arranged around the twig on all sides and are reduced to mere green scales, apparently not more than the sixteenth of an inch long. The male flowers (usually on different trees from the females) are in small brown or yellow clusters, an eighth of an inch long, on or near the ends of the smallest

branchlets. The fruit is a blue-black berry coated over with a white bloom, about one-fourth of an inch or less in diameter. It is made up of several united fleshy scales, and contains one or two seeds, which are brown in color and conical in shape. The berry has a pleasant odor when crushed.

The cedar is often, as we see it, a beautiful vegetable pyramid, tapering regularly from the base to the summit. This is when it retains all the branches with which it began. At other times it is a ragged, irregular, unsightly tree. This depends upon how many, and what particular, branches it has lost. Usually, as one may infer from the above, its shape will be determined by its age. The cedar tree was early recognized in England as valuable. Even before the Pilgrims had settled in Plymouth, vessels had carried the wood to the old world from the Elizabeth Islands. The tree gives name to Cedar Keys, in Florida, whence the wood is exported to manufacture lead pencils for the world. In the ground it lasts for a very long time. There are known instances of cedar posts remaining solid for more than one hundred years. Its pleasant odor has led to the wood being used for chests in which to put away clothing, carpet, rugs and similar things. Its warm red color beautifies the room that has been finished with it, and it is also used for railroad ties, but the wood is rather too soft to resist very heavy crushing weights. When obtained in natural curves, it makes the best timbers for small sail vessels. Formerly the rural physician used a decoction of the leaves as a substitute for, or in preparation of, savin cerate. Its berries, soaked in hot water, produce a tea supposed to stimulate the action of the kidneys.

Red cedar grows over a wide area in North America, and, as might be supposed, shows a corresponding degree of variation to adapt it to the great range of conditions under which it must live. It extends from New Brunswick to Florida, "west to the one hundredth meridian," and beyond, and re-appears in California, Oregon and Vancouver's Island. It is a tree of slow growth.

Physical properties, specific gravity, 0.4926; percentage of ash, 0.13; relative approximate fuel value, 0.4920; weight in pounds of a cubic foot of dry wood, 30.70; relative strength, 166.

CHAPTER XIII.

THE STATE BY COUNTIES.

Various unavoidable circumstances conspired to prevent the members of the Forestry Commission from visiting every county in the State before they were obliged to hand in their report to the Legislature. Such are indicated by a star in advance of the name of the county.

Of the counties from which our largest lumber supplies have been, or are being now, drawn, very careful examination has been made. It may be further added that it is in these counties also that the more important forestry problems of the State await solution. In every instance the proportions of timbered to cleared areas have been taken from the report of the Secretary of Internal Affairs, unless our special agents have been able to furnish a more detailed statement.* It is quite certain that some new additional classification of our land is required before we can hope for such accuracy as the statistical needs of the times require. For example, of the thirty-six per cent. of this State which is reported by the assessors to the commissioners of the various counties as being timber land, at least one-fourth is producing nothing which by any stretch of the imagination can be called timber. It should be made the duty of the assessors to give more attention to the exact acreage of cleared land at least. From this, deductions of some value might be drawn.

This lack of exactness is judiciously commented upon in Part II, pages 216-217, report of the Secretary of Internal Affairs for 1895. No classification of our woodland areas can be of great service if it fails to distinguish between lands producing underbrush, which never will attain tree size, and areas which are covered with a maturing second growth forest. Such classification should also indicate the location and quantity of original forest which now remains. These facts we should be in possession of, even if it costs something additional to obtain them.

The paragraph under each county which indicates the trees adapted to that particular region, as well as the soils in which they thrive best, has been taken from the report of the committee from the State Board of Agriculture, of which Dr. W. S. Roland, of York, was chairman. This was published in the annual report of the Board for 1882. It was the best statement of the facts available up to that time. The information was furnished to Dr. Roland by citizens of the various counties. We have not hesitated to supplement it when later information was at hand.

* As this volume was passing through the press, the latest available figures, taken from Annual Report of the Secretary of Internal Affairs for 1895, were substituted for those from the report of 1892.

***Adams county:**

Entire acreage estimated by geological survey,	339,200
Entire acreage estimated by assessors,	310,716
Acres of cleared land,	259,030
Acres of timber land,	51,686
Proportion of timber land to whole (per cent.),	16.5
"Trees that grow best are white oak, black oak, chestnut, hickory and locust.	
"Soil best adapted is low clay for white and rock oak; high gravel for chestnut."	

***Allegheny county:**

Entire acreage estimated by geological survey,	486,400
Acres of cleared land estimated by assessors, . . . . .	||30,097
"Trees that grow best are white oak, hickory, black walnut, locust, ash, maple and elm.	
"Soil adapted to the growth of all kinds native to the region, except pine and hemlock."	

***Armstrong county:**

Entire acreage estimated by geological survey,	390,400
Entire acreage estimated by assessors,	385,583
Acres of cleared land,	297,896
Acres of timber land,	87,687
Proportion of timber land to whole (per cent.),	22.7
"Trees that grow best are oak and chestnut.	
"Low land is best adapted for oak, upland for chestnut."	

***Beaver county:**

Entire acreage estimated by geological survey,	288,000
Entire acreage estimated by assessors,	255,948
Acres of cleared land,	203,561
Acres of timber land,	52,387
Proportion of timber land to whole (per cent.),	20.4
"Trees that grow best are white oak, locust and maple.	
"Clay is best for oak, high land for locust, and either wet or sandy for pine and maple."	

***Bedford county:**

Entire acreage estimated by geological survey,	640,000
Entire acreage estimated by assessors,	587,398
Acres of cleared land,	314,134
Acres of timber land,	273,264
Proportion of timber land to whole (per cent.),	46.5

! Why is this discrepancy so great ?

"Trees that grow best are white oak, rock oak, chestnut, sugar maple, locust and ash.

"Heavy soil is best for white oak; high and sandy for chestnut, rock oak and locust."

Remarks:

The county of Bedford is hilly, in many places mountainous. There yet remains a considerable body of the ordinary hard woods of our southern mountains. Some white pine and hemlock is reported from near the Fulton county side. A large part of this county would be better adapted to the growth of timber than to agricultural purposes, though three of its valleys (coves) are of great fertility. It might be remarked that shingle oak (*Quercus imbricaria*), which belongs ordinarily further south is occasionally found in Bedford, Somerset and Westmoreland counties.

***Berks county:**

Entire acreage estimated by geological survey,	576,000
Entire acreage estimated by assessors,	508,866
Acres of cleared land,	418,404
Acres of timber land,	90,462
Proportion of timber land to whole (per cent.),	17.7
"The trees that grow best are white oak, chestnut and hickory.	
"Heavy clay is best for hickory and a light soil for chestnut."	

Remarks:

From Joanna Furnace to Birdsboro the road lies mainly over a succession of wooded ridges, largely timbered with chestnut, rock oak and black oak, with some red oak, ash, sassafras and cedar. Here the timber is on the increase. For the last twenty-five years the second crop of timber has averaged a cord of wood a year per acre. The diminished demand for charcoal and fencing timber, is the chief cause of the increase in this region.

Chestnut Ridge, two miles from Pottstown, is a continuation of what at Honey Brook, in Chester county, is called the Welsh mountains. The timber is mostly chestnut, with considerable young black oak. It is tall, straight and in good condition. The growth on the average is about twenty-five years old, and will not exceed twenty-five cords to the acre.

Commission was able to make but a partial examination of the county.

***Blair county:**

Entire acreage estimated by geological survey,	326,400
Entire acreage estimated by assessors,	272,061
Acres of cleared land,	138,264

Acres of timber land,	133,797
Proportion of timber land to whole (per cent.),.....	49.1
"The trees that grow best are white oak, rock oak, chestnut and locust, hemlock and white pine.	
"Gravel and black slate are best for chestnut, locust and ash."	
This county has much waste land which should be utilized in producing timber.	

Bradford county:

Entire acreage estimated by geological survey.	742,400
Entire acreage estimated by assessors.	658,598
Acres of cleared land,	454,262
Acres of timber land,	204,336
Proportion of timber land to whole (per cent.),	31
"The trees that grow best are oak, chestnut, hickory, white pine, hemlock, beech, maple and bass."	

Remarks:

The country between Lovelton, in Wyoming county, and Sugar Run, on the North Branch, is highland, with good open ground and large farms. The chief crop is grass. There is about enough timber growing here for home consumption. The county is mainly an agricultural and grazing country. The numerous stump fences show that the county was once well covered with white pine. From two to four miles back from the river runs a low mountain, between Terrytown and Towanda, well covered with wood, but has little first-class timber.

Twenty-five per cent. of the region between Towanda and the head of Wysox Creek is timbered, of this not more than five per cent. is waste ground too poor or steep for cultivation. The country is hilly in character, and the tendency to the restoration of white pine very marked. There is some hemlock mixed with young quaking aspen along the streams. Yellow pine appears in a few places, and at one time may have been more common. Along the Wysox, black walnut was common, also elm, ash, shell-bark and the white walnut. Associated with the hemlock is yellow pine, sugar maple and beech. The twenty-five per cent. timber area would not average 4,000 feet B. M. to the acre.

Wysox Creek is a remarkable illustration of a stream which in wet seasons is a torrent. The valley through which it flows is flanked by steep hills, from which most of the timber has been removed. Hence the freshets and hence the dry bed. On the other hand, all the streams rising in wooded areas, though low, still carried water. The south branch of the Mehoopany in Wyoming county is largely wooded about its head streams. The bridges across it are low, but the water, either from snow or rain, seldom carries them away.

Along the line of the railroad from Towanda to Dushore forty per cent. of the land is timbered, mostly small white pine, hemlock, sugar and soft maple, and a little chestnut. The region has ceased to be an important factor in the lumbering business. The land, though not first-class still produces crops, but would probably be a better grazing than farming region.

In 1894 there remained a considerable body of hemlock and the ordinary hard woods (covering about 7,000 acres) in the region where the Shrader Branch heads.

***Bucks county:**

Entire acreage estimated by geological survey,	377,600
Entire acreage estimated by assessors,	356,148
Acres of cleared land,	335,103
Acres of timber land,	21,045
Proportion of timber land to whole (per cent.),	5.9
"The trees that grow best are white oak, chestnut, hickory, ash, poplar and maple.	
"Deep clay is best for white oak and hickory, gravelly for chestnut."	
Surface is too valuable for agriculture to figure conspicuously in forestry. There is very little waste land within its limits.	

***Butler county:**

Entire acreage estimated by geological survey,	524,800
Entire acreage estimated by assessors,	471,324
Acres of cleared land,	381,148
Acres of timber land,	90,176
Proportion of timber land to whole (per cent.),	19.1
"Trees that grow best are oak, chestnut, hickory, black walnut and ash.	
"Sandy loam is best for hickory and chestnut; clay for ash and wa'nut."	

Cambria county:

Entire acreage estimated by geological survey,	428,800
Total acreage,	426,240
Hemlock in acres, 5 per cent. of entire acreage,	21,409
Hemlock in feet, B. M.,	262,000,000
Hardwoods in acres, 9.1 per cent.,	39,600
Hardwoods in feet, B. M.,	309,000,000
Forest growth in acres, 16.3 per cent.,	90,000
Brush and waste lands, 39 per cent.,	164,940
Improved farming lands, 30.6 per cent. (F. R. M.),	130,300
"The trees that grow best are oak, chestnut, pine, hemlock, ash and maple."	

Cameron county:

Entire acreage estimated by geological survey,	243,200
Entire acreage estimated by assessors,	243,840
Hemlock in acres, 19 per cent. of total area,	46,402
Hemlock in feet, B. M.,	448,120,000
Pine in acres, 0.7 per cent.,	1,723
Pine in feet, B. M.,	16,830,000
Hardwood in acres,	4,575
Hardwood in feet, B. M.,	43,650,000
Forest growth in acres,	49,000
Acres of brush, slashings and waste lands,	122,633
Acres of improved land in farms, 8 per cent. (F. R. M.),	19,507
Large portion of county is waste land.	

***Carbon county:**

Entire acreage estimated by geological survey,	256,000
Entire acreage estimated by assessors,	166,132
Acres of cleared land,	65,840
Acres of timber land,	100,292
Proportion of timber land to whole (per cent.),	60.3
Northeastern part of Carbon county once was well covered by timber, white pine and hemlock. This is practically gone. The region needs forest restoration. In most of the remainder of the county the coal mining dwarfs all other industries.	

Centre county:

Entire acreage estimated by geological survey,	787,200
Entire acreage estimated by assessors,	337,308
Acres of cleared land,	195,471
Acres of timber land,	141,837
Proportion of timber land to whole (per cent.),	42
"The trees that grow best are oak, chestnut, hickory, locust and pine (white and yellow), hemlock.	
"Sandy and slate soil is best for pine, chestnut and locust; limestone and rich table land for hickory and walnut."	
Comparison of assessors with geological report (above) shows that less than half of Centre county has been reported (up to 1895) by its assessors.	

Remarks:

The Barrens are appropriately named. Their maximum width is about five and a half miles. There are some good farms, but over a large part, agricultural operations have proved unremunerative. Most of the area has been cleared once or more for charcoal. Thirty

or forty cords of wood (at best) can be taken from an acre, but it will require forty years to mature a crop that can be cut. The timber is very unequally distributed, owing to the varying quality of the land, some portions being wooded with the black oak (*Quercus tinctoria*), some with jack pine, others with second growth of white pine and chestnut. The land is assessed at \$10 an acre on the part that is not cleared, and on the part that has cleared land \$20 per acre. At this rate the timber growth will not pay the taxes. One-half of the area of the Barrens is farm land, of which the upper and lower ends are the best.

Fires occur yearly to a greater or less extent, caused by railroads, hunters and fishermen. They either burn out, or are put out by the citizens. In some parts of the county they are very destructive, and miles of young timber are frequently destroyed. Fires overrun the country about once in three years, lasting from one to four weeks on the mountains. There is no part of the country from which one may not see signs of extensive fires. In some parts the land is wholly burnt over.

On the route from Port Matilda to Philipsburg there is not, on an average, one white oak of a foot in diameter to the acre. The outlook is unpromising. Slow growths and fires seem to destroy all hope of speedy restoration under existing conditions. The lumbering interests of Philipsburg at present are on the wane. The region between Port Matilda and Philipsburg (thirteen miles), will not average over 2,000 to 2,500 feet to the acre, taking every tree above four inches in diameter.

The trip from State College to Millheim was through a fertile valley, and almost wholly through a rich limestone region. The forests occupying one-tenth of the surface are mainly oak and hickory, white and black oak predominating. From Potter's Fort to Millheim white pine trees 125 feet high, and two feet in diameter and upward, are common. Possibly 20,000 feet, B. M., of such trees may be seen in bunches at one time. There are many groves coming on, but as yet are unfit for use. (See Plate 39).

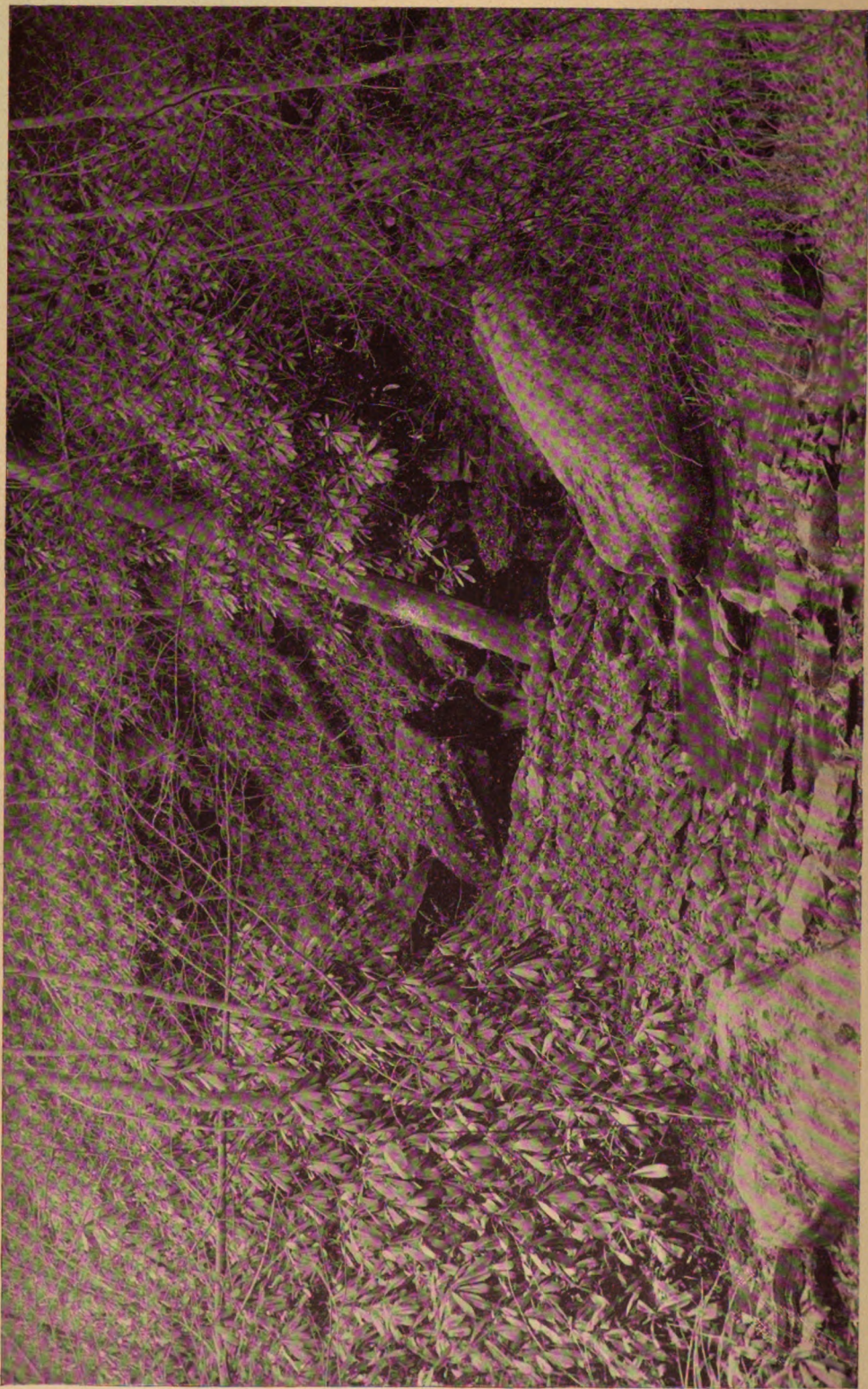
The valley in which Millheim lies is rich and fertile almost to the end of Round Top mountain. There the converging mountains shut out all hope of agriculture. There is but little woodland in the valley proper. At the Narrows the scene changes and dense woods cover the entire surface. The trees are largely white pine and hemlock from which the best have been removed. On the higher ground jack pine is common, with black and rock oak. The jack pine and rock oak of the higher ground may aggregate 500 feet to the acre.

On either side of Brush Valley is a fair quantity of young white pine, with some hemlock and considerable chestnut. But taking this whole region of eastern Centre county as a body the pine and



(Plate 39. See page 294.)

Road Scene Back of Millheim, Centre County.



(Plate 40. See page 224.)
Rhododendron Thicket, Spruce Run, Centre County.

hemlock have been practically cut off. The top of the mountains is covered with underbrush. In the Twelve Mile Narrows leading to Union county there was a heavy growth of white pine. It is now practically all gone. A vigorous growth of pitch pine is coming on. That at present will average 1,500 feet B. M. to the acre. Black oak is common on the lower grounds and will average 1,000 feet B. M. to the acre. Rock oak of good size is more common and will also average 1,500 feet to the acre, large and small. There is some chestnut. Near Sober Station, at the foot of the Seven Mountains, there is probably in sight 1,000,000 feet of hemlock of good size, still standing, and half as much white pine. On the higher ground between Sober's and the Lewistown pike, south of Potter's Bank, the growth is mainly chestnut, young and fit to be cut, probably an average of 1,000 feet to the acre. There is considerable jack pine on the hills. Much of the area has been cleared and is now in farms. This estimate probably covers fifty square miles; in line from Sober's toward Milroy in Mifflin county.

Along the Penn's Valley pike from the milestone between Centre and Union counties the land has been largely cut over. There is much black oak, some hemlock and pine. There is considerable good timber coming on.

Following the creek from Woodward Postoffice to Coburn, there is a splendid growth of white pine and hemlock ready to be cut. Much has been removed. On the seven miles between Woodward and Coburn, along the creek there was standing about 10,000,000 feet of white pine and hemlock, from one foot diameter and upward.

The region from Coburn, via Old Pike to Poe Valley, and thence down the valley to Penn's Creek, is practically all cut over. Much of it is absolutely stripped but is now covered with a fine growth of young chestnut. Here and there a small body of hemlock and white pine remains on an area of thirteen square miles. It would be a liberal estimate to place it at 4,000,000 feet of merchantable timber for the whole area, and none of it is mature.

The Boudinot tract back of Spruce run on the West Branch may be readily recognized, coming in from Pine Glen, by the higher and denser jack pine and yellow pine that remains. The region has been lumbered in the more accessible parts. The hemlock is of large size and mainly in the ravine. It is estimated there are 6,000,000 feet remaining. (See Plate 40).

The chief growth is jack and yellow pine. An acre scaled gave 9,600 feet B. M. Altogether there is probably 8,000,000 feet B. M. remaining. There is an abundance of good rock oak, some chestnut and cherry birch and some black and red oak. In part of the area is a growth of fine young white oak coming on, averaging one foot in diameter. It is a remarkably healthy growth. This grove does not exceed 200 acres. This timber being one of the City Trusts, is not

being cut off, but held for increased growth and advance in price. Fire has made serious havoc in the past, but owing to previous burnings most of the debris of earlier years has been burned, so that the risk of serious fires is correspondingly diminished. Add to this the facts, (1) the tract is watched, (2) it has the river on one side, (3) a road along much of the other side, and one may see the tract is relatively safe.

The Bear Meadow region, where Centre, Mifflin and Huntingdon counties join, has been almost wholly stripped of its very valuable timber, among which was some remarkably fine red spruce. Centre county is an empire in itself and a year might well enough have been given to it alone. (See Plate 41).

Chester county:

Entire acreage estimated by geological survey,	486,400
Entire acreage estimated by assessors,	440,018
Acres of cleared land,	387,422
Acres of timber land,	52,596
Proportion of timber land to whole (per cent.),	11.9

"The trees that grow best are white and black oak, chestnut, hickory, black walnut, locust and beech.

"Rich table land is best for hickory, walnut and oak; slate and gneiss for chestnut."

Remarks:

North Valley Hill, less than one-half mile across, with a thin slaty soil produces on the average about twenty cords of wood to the acre. As lumber, it would not average more than 4,000 feet B. M. to the acre. Most of it is second growth chestnut, with a considerable quantity of thrifty, young tulip-poplar, and about an equal quantity of rock oak, which is in good condition, but not more than half matured. On the flanks of this region there is some tall good white oak, considerable of which is well matured. There is some ash, but red and black oak are scarce. On the limestone ridges and hills the sugar maple is occasionally met with. There is some young black walnut, but it is not common.

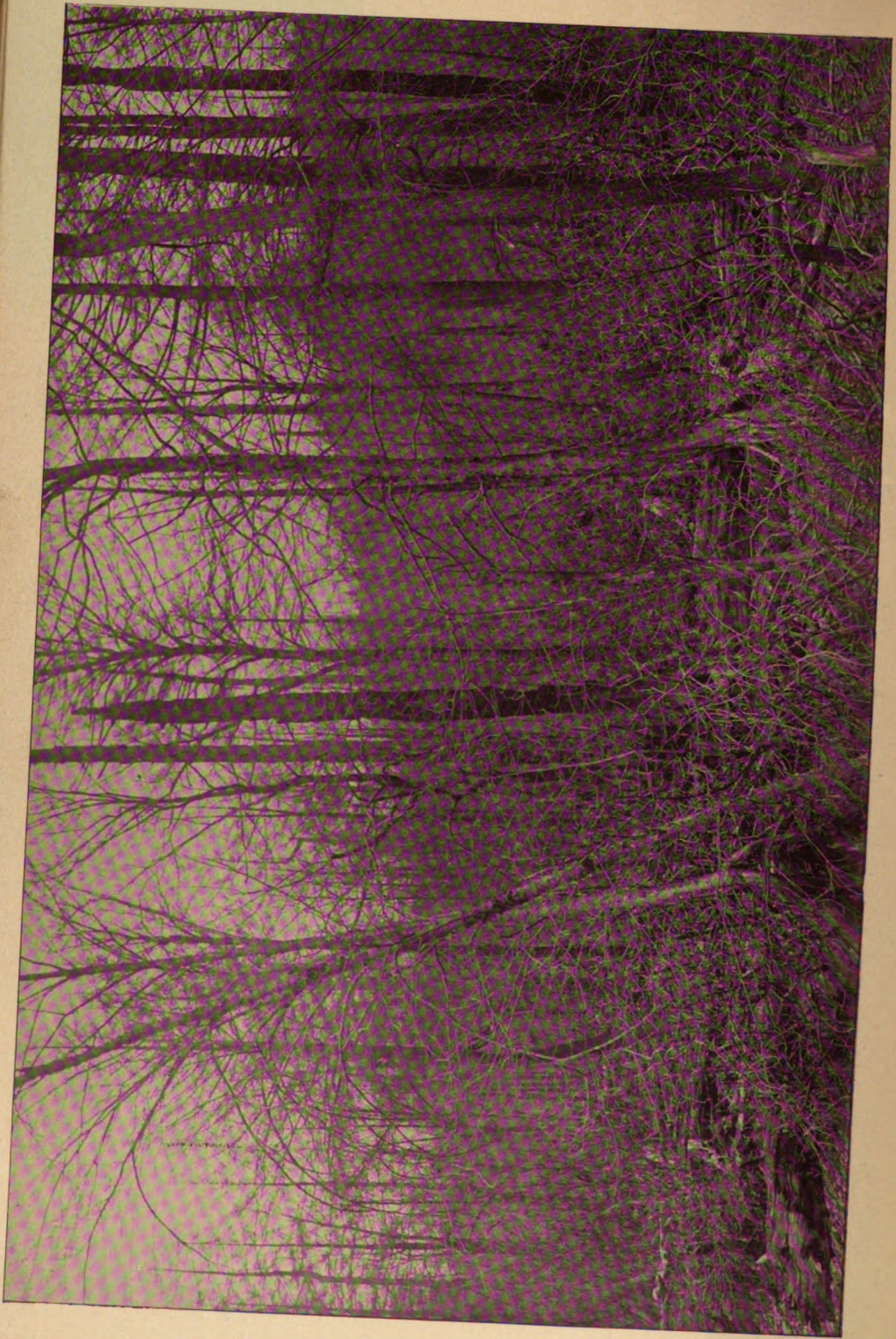
The timber is being rapidly cut, most of it being used for fencing purposes, some as cordwood and some for telegraph poles. Most of the land, now being cleared, is of small value for agricultural purposes, being hilly and slaty. As this region is not apt to suffer from fires, it should in forty or sixty years be restored to a good forest condition. The soil seems capable of producing a cord of wood per acre annually for fifty years under the most favorable conditions. North Valley Hill, about thirty miles long, is wooded over its entire length.



(Plate 41. See page 296.)

Timber Abandoned by the Lumbermen. Bear Meadows, Centre County.





(Plate 42.)

Timber Killed by Fire. Anderson's Creek, Clearfield County.



From Caln Meeting House to Waynesburg about ten per cent. of the country is wooded.

Chester county, though having a surface less diversified than some others of the Commonwealth, possesses naturally about sixty, out of the eighty-eight species, which I can enumerate as belonging to our State and attaining size meriting the name of tree. Out of these sixty species belonging to Chester county, there are but few which are distinctly localized. The most valuable species, have as a rule, a wide range over the county. On the serpentine ridges, it is true, one finds the post oak (*Quercus stellata*, Wang.) and the red cedar as characteristic trees; but they are not confined to such areas. Rock, or chestnut oak is likewise very commonly observed, along with the ordinary chestnut, on the slaty ridges, but they also are found elsewhere and simply predominate on poor soil because their hardy constitutions enable them to thrive where nothing else will do so well. There are some few species which may be regarded as rare, for example, the true Spanish oak (*Quercus falcata*, Michx.) and the yellow oak (*Quercus Muhlenbergii*, Engelm.). The most characteristic trees are, on the whole, chestnut, white oak, the shell-bark, white-heart and pignut and bitternut hickories, along with black walnut (now scarce), and tulip-poplar. The commonest of all is the chestnut, which sometimes attains a diameter at four feet from the ground of eight feet. The cone-bearing trees make naturally but a small showing here. In the northern part of the county the timber appears to be on the increase since the charcoal furnaces have suspended operations, and also because, being isolated, the forest fires have ceased to be so frequent or so serious. In the lower portions of the county the prevailing tree is the white oak, of which some magnificent specimens still exist. The higher ridges are still mostly timbered, as above described, and the lower grounds are in great part cleared. Hence the topography of the county is a key to the present forest condition. Chester county has but little land so poor and so rocky as to justify the appellation of waste ground. Tree culture will therefore be localized and determined wholly by the opinion that the owner may have as to a satisfactory financial return.

*Clarion county:

Entire acreage estimated by geological survey,	364,800
Entire acreage estimated by assessors,	359,175
Acres of cleared land,	287,628
Acres of timber land,	71,547
Proportion of timber land to whole (per cent.),	19.9

Clearfield county:

Entire acreage estimated by geological survey,	723,200
Entire acreage estimated by assessors,	723,200
Hemlock in acres, 8.7 per cent. of entire area,	66,630
Hemlock in feet, B. M.,	668,800,000
Pine in acres, 0.9 per cent.,	6,950
Pine in feet, B. M.,	67,500,000
Hardwoods in acres, 0.6 per cent.,	4,520
Hardwoods in feet, B. M.,	33,000,000
Forest growth in acres, 20.7 per cent.,	150,000
Acres of brush and waste land, 37.2 per cent.,	269,100
Acres of improved land in farms (F. R. M.), 31.9 per cent.,	230,000

Remarks:

Mr. F. R. Meier, writing from Ebensburg, under date of December 24, 1894, remarks that a prominent Clearfield lumberman and friend of the forestry movement said "that 100,000,000 feet of hemlock and 20,000,000 feet of pine (about sixteen per cent. of the whole amount of standing timber in Clearfield county), are destined to be cut by the 1st of June next in that county," (See Plate 43).

Clinton county:

Entire acreage estimated by geological survey.	550,400
Entire acreage estimated by assessors,	567,701
Acres of cleared land,	150,238
Acres of timber land,	417,463
Proportion of timber land to whole (per cent.),	73.5
"Trees that grow best are chestnut, pine (white and yellow) and hemlock.	

"Light mountain soil is best adapted for white pine and chestnut; limestone for oak, hickory and walnut."

Remarks:

Sugar Valley is poor and narrow at its lower end, but widens and becomes more fertile as we go east. On the sides of the valley there is considerable good white, black and rock oak. Crossing the valley from Booneville to Greenburg one sees some very fine white pine. One cleared field covered with stumps indicates an early enormous crop of white pine. In the gorges of Brush Valley especially the timber is mainly hemlock. Elsewhere there is a fair showing of rock and black oak and chestnut. The valley is largely cleared (one-fifth in wood). In the gorge above Greenburg, a dense growth of hemlock begins, probably averaging 15,000 to 20,000 feet

B. M. per acre. The trees are large, numerous and healthy. Going toward Livonia (Centre county) nearing the mountain top the hemlock begins to give place to chestnut and chestnut oak. Apparently on the mountains, peach orchards will produce a remunerative crop.

On the route from Lock Haven to Loganton, south from Salona, the washed and eroded character of the valley points to the disastrous freshets of 1889. Notwithstanding the distance from the railroad the hills have been absolutely denuded of timber, rendering them almost hopelessly barren. Fire has swept the country and for miles the scene is desolate. Some little pitch pine remains on top of the mountains, but it is being removed. The white pine grows on lower levels wherever it has a chance. On the southern slope toward Loganton there is a fine growth of rock oak, black and white oak. Most of the good timber is on the lower levels. That on the higher lands is nearly gone. The hemlock remains only in the mountain gorges, and the pitch pine on the mountain tops.

From Loganton to White Deer creek, the valley gradually narrows. The mountain sides to the north are quite densely clad with the *Pinus rigida*; also some white pine, possibly 1,000,000 feet. The mountains on the south side have several patches of white pine about 2,000,000 feet B. M. in all, and probably 1,500,000 feet prime hemlock. At the foot of the mountain on the south side there is good white and black oak, aggregating about 2,000,000 feet B. M.

In the region between Loganton and Jersey Shore, possibly 10,000,000 feet of hemlock might be taken from the valley and hillsides.

The whole region between Beech Creek and Keating, excepting perhaps one-tenth, is too poor for profitable agriculture. On part of the better grounds there is a fair growth of white oak, which would probably make ten cords to the acre. One is struck by the absence of chestnut. The entire region has practically been cut over. Its sole natural function is the production of timber, except where the coal mining industry may in future dwarf all others. There were fewer traces of fire than usual over the region.

There are about thirty-two square miles of natural timber land between Keating and Lock Haven (along the river) on which at present there is not an average of 1,500 feet of merchantable timber per acre.

In going from Queen's Run to Jersey Shore, one enters a series of mountain gorges and finds practically no timber. All, even the pitch pine, has been largely removed. The ravines of the higher grounds may be considered wholly unfit for any remunerative agricultural purpose. They contain extensive deposits of fire clay, which is being worked in some places. The table land or broad ridges (on top) does seem to have some agricultural possibilities in places.

The steeper slopes from Queen's Run back to Haneyville, that face the numerous streams may be regarded as only fit for timber. In

all this area there are probably only two or three million feet of white pine of merchantable size remaining. If simply protected from fire for fifty years, this region will have at least 10,000,000 feet of marketable white pine, which is already well advanced. At the head of Lick Run, there is a body of mature hemlock that will aggregate 12,000,000 feet. This is to be cut.

Chestnut, chestnut oak, red and black oak appear on the higher grounds along the line between Clinton and Lycoming counties, in small quantities. This area is fit for timber only. The pitch pine averages only 1,500 feet per acre and it is the best remaining crop. Along the streams which head here there is a small quantity of black or cherry birch.

The road from Pumping Station to a point twelve miles north of Lock Haven lies through a sandy soil, a region of jack pine. Fires raged during the spring of 1894, and much of the country was burned over.

From Lock Haven to Nittany Hall (in Centre county) the road lies through a limestone region, mostly cleared, but with a marked tendency to the reproduction of white pine. White oak was common, and there was some hickory and black walnut.

On the road from Cross Fork to Renovo the timber is pretty much cleared. There is here and there a white pine or a hemlock, and scattering rock oak and chestnut, and occasionally some sound young white oak of short growth. Forest fires have been the curse of the region.

The large bodies of hemlock on Hammersley Fork and Young Woman's Creek are being rapidly removed. A considerable body of hemlock and white and Norway pine still remain at the head of Hyner's Run.

The Tamarack Swamp contains larch, balsam and (black?) spruce. It covers about 1,000 acres and may contain 500,000 feet of good timber yet. This swamp is a bottomless mass of sphagnum and contains pitcher plants along with ordinary northern flowers.

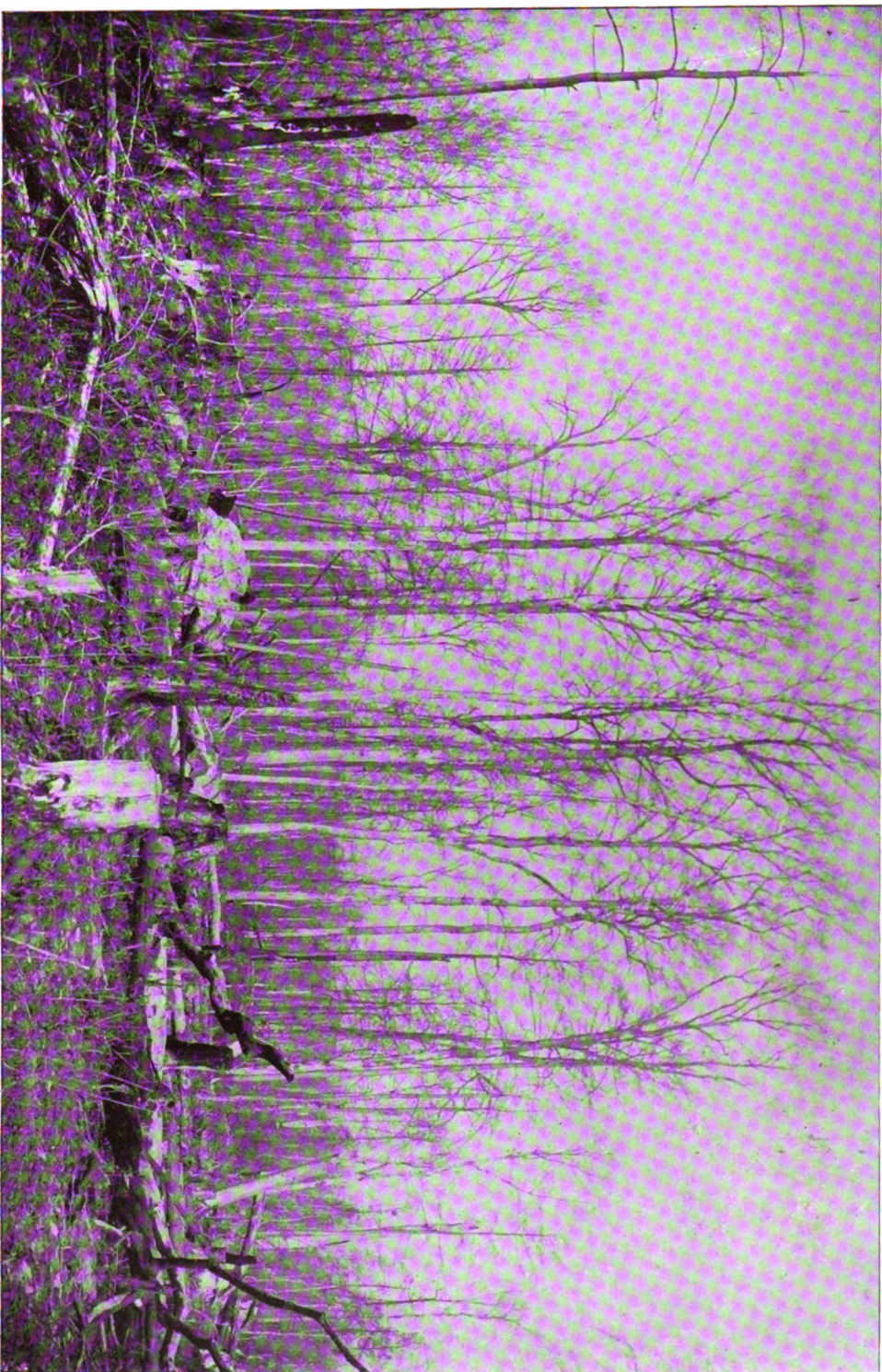
Mr. J. J. Nutting, of the Lock Haven Mills (manufacturers of paper from wood pulp), says, "In regard to the consumption of wood, and the kinds, we use on an average 40 cords of 128 feet each per day. Two-thirds of this is jack pine and is second growth stuff, and of no value as lumber. The yield per cord varies from 800 to 1,200 pounds, according to the quality and kind of wood.

"We also use second-growth, soft, white maple, some slab wood, poplar, linn, cucumber and quaking aspen. We do not use spruce or wood merchantable for lumber. Our supply comes almost wholly from farmers, who cut the wood in the winter time when there is nothing else to do, and when there is no other work for their teams."



(Plate 43.)

Curry's Run, Clearfield County. Used for "Running Logs" During High Water.



(Plate 44. See page 308.)

Mature Hardwood, Killed by Fire. Jefferson County, near Falls Creek.



Columbia county:

Entire acreage estimated by geological survey,	307,200
Entire acreage estimated by assessors,	283,483
Acres of cleared land,	186,617
Acres of timber land,	96,866
Proportion of timber land to whole (per cent.),	34.2

"Trees that grow best are oak and chestnut (white pine and hemlock).

"Chestnut grows best on the ridges; pine, hemlock and oak in the low lands and swamps."

Remarks:

Near the headwaters of Little Fishing Creek, half grown hemlocks and smaller pine and beech are abundant almost to Millville. Frequent small lumber piles indicate that lumbering operations are in the hands of small operators. Very fine white or American elm is found within two miles of Bloomsburg. There are a large number of places in which there are dense groves of white pine coming on. Red oak is common and there is a little rock oak.

Between Catawissa and Numidia the soil produces good crops, but must be kept in condition by fertilizers. Oak, red, white and rock, are conspicuous figures in the landscape. Small patches of white pine as well as yellow pine are found here and there on the steeper hillsides. The region south of the Susquehanna has not more than twenty-five per cent. of its area in wood land, much of which is not mercantable timber. The mountains along the river, the Catawissa and Little mountains, have some remaining timber, mostly cullings and after growth, not averaging 1,500 feet to the acre.

***Crawford county:**

Entire acreage estimated by geological survey,	640,000
Entire acreage estimated by assessors,	601,959
Acres of cleared land,	424,780
Acres of timber land,	177,179
Proportion of timber land to the whole (per cent.). .	29.4

"Trees that grow best are oak, chestnut, hickory, pine, ash, hemlock, poplar, beech, maple and elm.

"Gravel, loam and clay subsoils are best for oak, chestnut, beech and maple; low lands of deep alluvial character for pine, bass, cucumber, etc."

***Cumberland county:**

Entire acreage estimated by geological survey,	352,000
Entire acreage estimated by assessors,	312,346
Acres of cleared land,	239,841
Acres of timber land,	72,505
Proportion of timber land to the whole (per cent.), . .	23.2

"Trees that grow best are white oak, black oak, red oak, chestnut, hickory and pine.

"Limestone is best for oak, hickory and locust; gravel for pine and chestnut."

The mountains on the north and south boundaries still produce a small quantity of timber but should produce much more if under proper supervision and protection. A large part of Cumberland county is too valuable for production of cereals ever to be given up to timber, except on the main mountain slopes and tops.

Dauphin county:

Entire acreage estimated by geological survey.	332,800
Entire acreage estimated by assessors.	322,793
Acres of cleared land,	230,719
Acres of timber land,	92,074
Proportion of timber land to whole (per cent.),	28.5

"Trees that grow best are rock oak, chestnut and locust.

"Mountain soil is best for chestnut and locust."

Remarks:

Black walnut, the various species of hickory, and white oak might advantageously be grown in the small waste areas about the farms of this county. There is also a considerable area of mountain land, which has in the past grown and still should furnish most of the poorer sort of timber required in the neighborhood. Owing to the railroads at the base of the mountain the damage by fire is frequent and serious. Much of the thin soil in the northern part of the county would yield larger returns in trees than in anything else.

Delaware county:

Entire acreage estimated by geological survey,	127,600
Entire acreage estimated by assessors,	121,500
Acres of cleared land,	110,000
Acres of timber land,	11,500
Proportion of timer land to whole (per cent.),	9.4

"Trees that grow best are oak (white and red), chestnut, hickory (various species of) and locust.

"Light soil is best for chestnut, rich for locust and walnut."

Remarks:

The lower grounds and the tidewater areas of Delaware county are admirably adapted to the growth of the sweet gum (*Liquidambar*). No portion of the State originally produced a better quality of white oak than Delaware county. Owing to its proximity to salt water, as well also as its southern position, it has more of the characteristic trees of the south than any other county in the State.

Elk county:

Entire acreage estimated by geological survey,	492,800
Entire acreage estimated by assessors,	492,514
Acres of cleared land,	115,063
Acres of timber land,	377,451
Proportion of timber land to whole (per cent.),	76.6

"Trees that grow best are white pine, hemlock and maple."

Remarks based on later data, and careful, actual examination:

Elk county contains about 494,000 acres of which approximately there are 216,000 acres of timber land and 278,000 acres of cleared land.

Of the timber land there is from 140,000 to 150,000 acres of hemlock, say, approximately 145,000 acres still standing, which yielding we will suppose 15,000 feet B. M. to the acre, would amount to 2,175,000,000 feet.

Of white pine there may be 3,000 acres more or less. If it averages 10,000 feet to the acre, it would amount to 30,000,000 feet.

Of hardwoods (chestnut, ash, maple, basswood, poplar, oak, beech, birch, cherry and cucumber) it is estimated there are from 1,200 to 1,500 million feet standing at present on the ground. We will call it 1,400 millions feet which it will probably reach, and averaging 2,800 feet to the acre, we shall have the probable area of hardwood growth. These trees are unequally scattered over the timber land, particularly among the hemlock; a few trees of a kind in one place and a generous supply in another place. Taking it as a whole we can hardly expect Elk county to compete in agriculture successfully with the most fertile counties of the Commonwealth. It would appear as though the best use to which its high surface could be put would be timber growing. It may have a future as a grazing ground.

***Erie county:**

Entire acreage estimated by geological survey,	492,800
Entire acreage estimated by assessors,	444,820
Acres of cleared land,	396,288
Acres of timber land,	48,532
Proportion of timber land to whole (per cent.),	10.9

"Trees that grow best are oak, chestnut, hickory, black walnut, pine, hemlock, ash, poplar, beech, maple and bass.

"Clay bottom is best for oak, hickory, walnut and hemlock; gravel and sandy for chestnut, maple, poplar and cucumber."

Erie county once had a generous supply of good white pine. It now has but little. A most important forest industry there is manufacture of a fine quality of maple syrup and sugar, an industry worthy of even greater attention.

***Fayette county:**

Entire acreage estimated by geological survey,	531,200
Entire acreage estimated by assessors,	463,350
Acres of timber land,	307,555
Acres of timber land,	155,795
Proportion of timber land to whole (per cent.),	33.6

"Trees that grow best are oak, chestnut, black walnut, locust and poplar.

"Rich loams are best for walnut, locust and poplar."

Fayette county should receive a careful examination, which up to this time the Forestry Commissioners have not been able to give it.

Forest county:

Entire acreage estimated by geological survey,	275,200
Entire acreage estimated by assessors,	281,985
Acres of cleared land,	178,902
Acres of timber land,	103,083
Proportion of timber land to whole (per cent.),	36.5

"Trees that grow best are chestnut, hemlock, ash and poplar.

"Clay and hard pan are best for oak and pine; limestone for white pine."

The following additional information has been received from Samuel D. Irwin, Esq., Tionesta, of the cleared and timber lands in Forest county, for the year 1895, as returned by the assessors of the several districts, and also the estimate of F. F. Whittekin, surveyor and civil engineer:

Township.	Cleared land. acres.	Timber land. acres.
Barnett,	14,366	5,247
Green,	15,284	8,628
Harmony,	19,345	791
Hickory,	15,834	6,460
Howe,	24,334	34,318
Jenks,	31,050	33,600

Township.	Cleared land. acres.	Timber land, acres.
Kingsley,	34,000	10,000
Tionesta,	24,015	4,039
Tionesta borough,	674	.....
Total,	178,902	103,083

Area of the county, according to estimates by F. F. Whittekin, surveyor and civil engineer: 337 square miles or 215,680 acres. County map, 1895.

Amount of land assessed (acres),	281,985
Amount of land as per Whittekin (acres),	215,680

Mr. Irwin's estimate of the merchantable timber, board measure, standing in the county, is as follows:

Hemlock (feet),	700,000,000
Pine (feet),	350,000,000
Oak and chestnut (feet),	100,000,000
Beech, birch, white wood, maple, etc. (feet),	300,000,000
Total (feet),	1,450,000,000

Beech, birch and maple are very plenty in the eastern part of the county.

Franklin county:

Entire acreage estimated by geological survey.....	486,400
Entire acreage estimated by assessors,	427,588
Acres of cleared land,	292,887
Acres of timber land,	134,701
Proportion of timber land (per cent.),	31.5

"Trees that grow best are oak, chestnut, black walnut, hickory and locust.

"Limestone and black slate is best for white and rock oak, hickory and walnut; sandy soil for chestnut."

The western mountain border was once well wooded. The best timber has been removed. Chestnut, rock oak, locust and black birch still remain, but the crop is neither so dense, so large or so valuable as the first one. The mountains in the southeastern part also contain considerable land better adapted to forests than to any other crop. But as a whole, Franklin is, and will remain an agricultural county.

Fulton county:

Entire acreage estimated by geological survey,	281,600
Entire acreage estimated by assessors,	236,808
Acres of cleared land,	112,667
Acres of timber land,	124,141
Proportion of timber land to whole (per cent.),	52.4

Remarks:

Big Cove, in the southeastern part of this county, is its chief agricultural region. Taking the southern half of the county, exclusive of the Big Cove, not more than one-half under any circumstances is fit for agriculture, and of this not more than one-fifth can be considered as remunerative farm land. The actual condition of four-fifths of the land under cultivation (exclusive of the cove), in the southern half is far from satisfactory. A large part of the area is absolutely worn out by long continued attempts at cultivation. The absence of railroad facilities, the bad roads and the hilly character of the country have rendered markets difficult to reach. The consequence is lack of effort to do good farming or to produce more than the wants of the country require. Buckwheat is a great staple of the county. The whole tendency of the poorer half of the county is toward impoverishment. Unless conditions change, depopulation seems to be the inevitable tendency, though as yet there are few abandoned homes. It should be stated in this connection that in no part of the Commonwealth is there a more industrious, law abiding or moral community than in Fulton county.

The Big Cove is an area of fine agricultural possibilities. The floor is of Trenton limestone, which though making a "stiff soil to work" nevertheless produces well. There is a small area of Clinton Water Lime in the southwest part of the county which is fairly productive. The southern half of the central part of the county is not good farm land, but does produce fairly good white oak, black oak and chestnut.

It is clear that in the long run the whole region of the Chemung and Hamilton rocks would be of greater service to the State if it were devoted to the growth of trees. Grazing might possibly become an important interest, but through almost the whole of the county, except the limestone region, the soil is of so loose a character and the surface so hilly that the fertility is becoming rapidly washed out. High bridges over the streams indicate high stages of water after heavy rains, though it appears that little pecuniary damage results from the freshets.

On the mountain sides yellow and pitch pines are common. On "Sideling Hill" there is considerable *pinus pungens*, here called "poverty pine." White pine is scarce, though there are a few trees

two feet through and of good height. The tendency to early decay is obvious. Hemlock is scarce and of small size. Hickory (white heart) of medium height is evenly distributed. Shell-bark and walnut of small size are common in the low lands and butternut fairly plentiful. There is considerable of the swamp white oak, though it forms no important part of the silva.

There is said to be a small quantity of white pine along the Bedford county border.

A smaller portion of the area of Fulton county is covered with underbrush and scrub timber than of either Mifflin, Centre or Union counties, for the reason that it has not been lumbered over; then abandoned. It has been mainly cleared to open farms. The only active destroying agencies were charcoal furnaces and tanneries; the latter using mainly rock oak bark.

The wooded part of the country is burned over about once in three years. Extensive areas on the mountain sides have been recently destroyed by these fires.

***Greene county:**

Entire acreage estimated by geological survey,..... 396,800

Entire acreage estimated by assessors,.....

Acres of cleared land, 336,990

Acres of timber land, 59,810

"Trees that grow best are oak, black walnut, locust, and poplar.

"Heavy clay is best for oak, and loamy land for walnut and poplar."

The Forestry Commission, limited by time, was unable to make a personal examination of this county.

Huntingdon county:

Entire acreage estimated by geological survey, 576,000

Entire acreage estimated by assessors, 483,318

Acres of cleared land, 245,178

Acres of timber land, 238,140

Proportion of timber land to whole (per cent.), 49.2

"The trees that grow best are the white oak, chestnut, locust, pine, hemlock and maple.

"Clay and limestone are best for oak; mountain ridges for rock oak, chestnut and locust; low rich land for walnut and all other kinds."

A large portion of Huntingdon county is either ridge or mountain land. Of the former much would in twenty years be more valuable in timber than as farm land. The whole value of the mountain land, so far as the production of a crop goes, is in the timber it can produce. The valleys contain much good farming land, especially near the limestone.

Indiana county:

Entire acreage estimated by geological survey,	531,200
Entire acreage estimated by assessors,	529,920
Hemlock in acres, 0.8 per cent. of entire area,	4,270
Hemlock in feet, B. M.,	53,810,000
Pine in acres, 0.6 per cent.,	3,190
Pine in feet, B. M.,	42,890,000
Hardwood in acres, 0.9 per cent.,	4,890
Hardwood in feet, B. M.,	46,810,000
General forest growth in acres, 5.6 per cent.,	29,900
Acres of brush, slashings, waste and burned lands, 21.7 per cent.,	114,700
Acres of improved farming land, 70.4 per cent.,	372,970

"Trees that grow best are white oak, chestnut, hickory, black walnut, white pine and hemlock.

"Heavy soil is best for oak, walnut and hickory; gravel and sand for chestnut and pine."

The estimates, except the first two lines, were made by a special agent, Mr. F. R. Meier, and may be regarded as a near approximation to the truth, for the time they were taken, October, 1894.

Jefferson county:

Entire acreage estimated by geological survey,	409,600
Entire acreage estimated by assessors,	413,440
Hemlock in acres, 5 per cent. of total area,	21,082
Hemlock in feet, B. M.,	291,300,000
Pine in acres, 1 per cent.,	4,155
Pine in feet, B. M.,	71,030,000
Hardwood in acres, 3 per cent.,	11,300
Hardwood in feet, B. M.,	141,200,000
Acres of brush, waste, slashings and burned lands, 40 2-3 per cent.,	169,103
Acres of farming land, 50 1-3,	208,000

"The trees that grow best are white oak, chestnut, black walnut and white pine.

"Rich loam is best for walnut and white oak; light soil for chestnut; any soil for pine."

The estimates of particular kinds of timber in acres and feet are made by Mr. F. R. Meier, special agent. At various times this county has suffered severely from forest fires; especially along the Clearfield border. (See Plate 44).

Juniata county:

Entire acreage estimated by geological survey,	257,000
Entire acreage estimated by assessors,	219,528
Acres of cleared land,	144,319
Acres of timber land,	75,209
Proportion of timber land to whole (per cent.),	34.2

"Trees that grow best are oak (white, black and rock), chestnut, hickory (four species) and black walnut.

"Sandy soil is best for chestnut; limestone and clay for other kinds."

Remarks:

Recent observations indicate that lands which have been unremunerative from an agricultural standpoint, and which cannot be counted on to produce more than eight bushels of wheat to the acre, will in peaches or small fruits yield an average annual net profit of \$50 per acre.

As at present determined, fifteen years is the fair, average life of a peach orchard. At or before that time, the trees will cease to produce new wood in any quantity and will almost certainly fall before the "yellows."

Rich soil will produce the most rapid growers; but it is a question if they are the best bearers. Mr. Smith states that the only fertilizers he uses are chicken droppings and wood ashes. His experience with chemical fertilizers is limited.

To insure good crops, it seems essential that the soil should be cultivated and the weeds kept down. Two or three years' neglect means the loss of the crop.

The peach growers are "at sea" in regard to the "yellows." In many instances the dead and dying trees, after being cut down are allowed to remain where they fell for a considerable time. The result is inevitable, of course. It seems evident that the affected trees or brush must be immediately removed far away, or better still, burned immediately.

It cannot be doubted that if a market were assured for peaches, raspberries, blackberries and strawberries, and for string beans and onions, much of the slaty, gravelly soil of Juniata county could be profitably devoted to the above named fruits and vegetables; but the near proximity of canning and evaporating establishments would be essential.

At least a fourth of Juniata county would be worth more twenty-five years hence if it were in thrifty young timber than it could possibly be in any other crop, unless we except the peaches and small fruits, alluded to above. The chief mountain ranges are fit for nothing else than to produce timber.

For Black Log region see Mifflin county.

Lackawanna county:

Entire acreage estimated by geological survey,	281,600
Entire acreage estimated by assessors,	237,694
Acres of cleared land,	199,626
Acres of timber land,	38,068
Proportion of timber land to whole (per cent.),	16

"Trees that grow best are oak, chestnut, hickory, black walnut, hemlock and maple.

"Mountain soil is best for oak and pine; bottom lands for white ash, walnut, hickory, etc."

Remarks:

From Forest City south to Pittston there is practically no timber. The Lackawanna Valley, originally well wooded, is now denuded. The mining interest subordinates all others. Agriculture will never again be a ruling interest in that valley. It is therefore the more urgent that these grounds, now overgrown with sprouts, should be made tree-producing. The mountain ridge to the west of the Lackawanna is nearly bare of any tree growth, though the surface has no other value at present than for the growth of trees.

Mr. Sisson, at La Plume, has a healthy and profitable sugar camp of 600 trees in a wood, from which he allows no underbrush to be removed. The ground is then shaded and the trees have their roots so protected that they do not dry out and perish. Hickory is abundant in these woods.

Ironwood a foot in diameter is plenty. There is also considerable beech and hemlock. There is no white pine standing, but large stumps testify to what has been in that region.

The mountains of Lackawanna county are often capable of cultivation almost to the top.

Of the mountain land which is in timber, but a small portion (of the timber) has any real value. The growth is mostly of unimportant kinds. There is reason to think that it might be well worth while to place the more barren surfaces of this county in trees of such species as would promptly produce timber suitable for mine props. The northwestern part of Lackawanna county has here and there scattered bodies of mature hardwood, beech, sugar maple, and birch (mostly yellow).

Lancaster county:

Entire acreage estimated by geological survey,	620,800
Entire acreage estimated by assessors,	571,846
Acres of cleared land,	514,765
Acres of timber land,	57,081
Proportion of timber land to whole (per cent.),	9.9

Remarks:

Lancaster should hardly be regarded as a county for extensive forestry operations. It is pre-eminently an agricultural area, one of the richest in the United States. Here and there a few acres of waste land might be devoted to the growth of trees. There are but few species, if any, of our better sorts that would not thrive within its limits. White oak, the hickories, black walnut, white ash and white elm all grow well and produce good timber.

From Honey Brook, in Chester county, to the Welsh mountains, along the Churchtown road, is a rich agricultural valley. Ascending the mountains on the north, there is a rich quartz region. Timber averaging 15 cords to the acre covers the whole mountain range. It is mainly chestnut, with a sprinkling of rock, black and red oak, and some hickory and tulip-poplar. From Churchtown east to Morgantown there is but little timber remaining.

The whole border between Chester and Lancaster counties still produces a moderate quantity of chestnut and the various oaks—mainly white oak on the low ground, and rock oak on the slaty ridges. On the trap region, near the Dauphin county line, which is hardly suitable for agriculture, a sparse growth of cedar is coming slowly and spontaneously. It seems, however, to be capable of producing the other forest trees of the county.

The southwestern border of Lancaster county, fronting on the Susquehanna, presents, for the southern twenty-five miles, a more or less precipitous front, toward the river, which (front) is broken here and there by streams descending from the table land back, and which have worn out ravines at right angles to the course of the river. These steeper parts are, in the main, covered by a growth of woods, in which chestnut, hickory, white oak and rock oak predominate. Black walnut once was quite common and this fact would indicate that it could be easily restored in time.

***Lawrence county:**

Entire acreage estimated by geological survey,	236,800
Entire acreage estimated by assessors,	224,417
Acres in cleared land,	208,149
Acres in timber land,	16,268
Proportion of timber land to whole (per cent.),	7.2

"Trees that grow best are white oak, black oak, chestnut, hickory, ash, poplar, birch and maple.

"Clay is best for the oaks, gravel for chestnut, rich loam for walnut, moist bottom for pine, maple, etc."

Lebanon county:

Entire acreage estimated by geological survey,	224,000
Entire acreage estimated by assessors,	209,236
Acres in cleared land,	165,104
Acres in timber land,	44,132
Proportion of timber land to whole (per cent.),	21.1

"Trees that grow best are white oak, red oak, chestnut, hickory, black walnut, locust.

"Limestone is best for oak, walnut and hickory; gravel for chestnut; sandy loam for locust."

Lebanon county except in its northwestern part, has but little, really waste land within its limits, and therefore, will never figure conspicuously in production of lumber. It is capable of producing any species of native tree, and therefore the farm wood lot should not be wholly neglected.

Lehigh county:

Entire acreage estimated by geological survey,	230,400
Entire acreage estimated by assessors,	186,329
Acres in cleared land,	171,492
Acres in timber land,	14,837
Proportion of timber land to whole (per cent.),	7.9

A rich agricultural county, with but a small portion of its area which can be considered as better adapted to the growth of trees than to farming operations. It should be remarked that it is one of the few counties in the State which exercises any care to extend to its timber land a legal protection against forest fires.

Luzerne county:

Entire acreage estimated by geological survey,	582,400
Entire acreage estimated by assessors,	577,548
Acres in cleared land,	283,542
Acres in timber land,	294,006
Proportion of timber land to whole (per cent.),	50.9

Remarks:

In going from Wilkes-Barre to Stroudsburg, Monroe county, timber begins at the Mauch Chunk red shale. Jack pine, white, black and rock oak are growing thickly, but are small. At an elevation of 500 feet above the valley one finds chestnut and rock oak. The land is thin and but little mature timber remains, the best having been cut off. Fire has run over the region. There is some gum and some hickory. Nine hundred feet above the valley there are some hun-

dreds of acres of cleared land, forming fairly good farms. Here are found yellow birch and sugar maple; also black and cherry birch. Farther on towards the south are found white ash, much quaking aspen and considerable small white pine and hemlock.

The mountains east of Wilkes-Barre, on their northwestern faces, have been almost stripped of good timber. There is some rock oak, red oak and jack pine and some chestnut. Near Oliver's Mills there is obvious improvement in forest culture. General Oliver vigorously fights the periodical fires, keeps his woodlands clear, and his roads act as safeguards.

The whole Bear Creek and Bear Lake region is practically cut off. About 1,000,000 feet of inferior lumber remain near Bald Mountain. At Meadow Run the picture of desolation is complete. The buildings are unoccupied and the mill is gone. Yet the whole region, though burned over and cut over, is a natural sponge, of the greatest importance as a reservoir, for collecting water.

Near Beaumont, in areas now utterly unproductive, are numerous large pine stumps remaining to testify to its lumber producing capacity. Black birch saplings are extensively used for the distillation of birch oil. An ordinary two-horse wagon load gives two pounds of oil valued at \$1.40 a pound. The tendency to the production of white pine in this region is very marked. The old, abandoned fields are somewhat covered with a growth of this, and also of luxuriant yellow pine. Chestnut and soft maple make up the bulk of the second crop, with the usual proportion of scrub oak and young white oak. There are a few larch trees near Bear Lake.

From Stoddartsville down the Tobyhanna region (Monroe county) and that of Hayes' Run every thing is cut off. There are a few scattered poor farms; all the rest is utterly waste and desolate. In this very region, which recently produced so much valuable white pine and hemlock, boards, for building purposes, are hauled from White Haven, ten miles away. Fully one-half of the region has been recently burned over. The only lumbering industry apparent is an occasional lath mill working up the small stuff. Shingles are still made by hand out of white pine logs which have lain on the ground probably fifteen years. (See Plate 45).

In going from Wyoming to Dallas perhaps sixty per cent. of the land is cleared. The country is hilly, the timber remaining principally on the steeper hillsides and higher summits. There is no white pine, but considerable chestnut and black oak along the creek. There are perhaps 5,000 feet of hemlock to the mile, but the mature timber will not average 1,500 feet to the acre.

There still remains some valuable hemlock and hardwood in the northwestern part of the county, but it is being cut so fast that its early disappearance is assured.

Lycoming county:

Entire acreage estimated by geological survey,	771,200
Entire acreage estimated by assessors,	727,788
Acres of cleared land,	230,013
Acres of timber land,	497,775
Proportion of timber land to whole (per cent.),	64.8

Remarks:

In going from Picture Rocks to Big Bear Creek one can see from the mountain side above Huntersville that although the steep hill-sides bordering on the streams are more or less densely covered with a second growth of white, black and red oak and hemlock and white pine, the county is about one-half cleared looking towards Picture Rocks and Montoursville. From the top of the mountains to Barbour's Mills there was a good growth of timber, including much white pine. The region is now "skinned." About all of merchantable size that remains is the yellow and jack pine, averaging not more than 1,000 feet to the acre.

As we approach Barbour's Mills there is considerable birch remaining with some beech and maple, probably 2,000 feet to the acre. In following the Loyalsock up to the Sullivan county line we found the banks along the streams moderately well covered with hemlock and hardwood. The bottoms are fertile and have large maple trees and considerable buttonwood, beech and basswood. One is particularly struck in passing along this route with the white walnut trees growing among the rocks on the dry hill side. Some of them were over two feet through at the butt and sent up tall, straight trunks from 40 to 60 feet high.

The road from the Sullivan county line to Proctorville lies through a country that for four miles is almost entirely cleared. This section represents a part of the area denuded by the Proctorville tannery. This cleared area does not appear to be fertile, and farming is only an after-thought.

At Barbour's Mills my attention was attracted by a red oak stump measuring four feet across its face. It is very remarkable that this tree made more than half its growth in fifty years.

Going in a southwesterly direction from Barbour's Mills we find a promising young growth of rock oak, red and black oak, some chestnut and pine and a little of the red or Norway pine (*Pinus resinosa*). The valley that extends along the southern face of the mountain towards Huntersville has rich land and is fifty per centum cleared. On East Mill creek there is considerable large white pine among the hemlock. There are a few tracts still uncut along this section, and probably fifty per centum of the section is in timber.

The increase in the quantity of chestnut oak is quite apparent on the line between Plunkett's creek and Mill Creek townships. The same may be said of the growing white pine, which does not seem to extend much north of Loyalsock. Oak constituted half of the silva. Maple is not so common, but black walnut is more so along the valley of the Loyalsock creek. At a town of the same name (Loyalsock) the river form of the rock oak is common, and also the river birch. Rose Valley is a depression northwest from Loyalsock, four or five miles long by one to one and one-fourth wide. It produces good crops, but the soil does not wear well. The Trout Run region is perhaps half timbered as a whole, but most of the hemlock has been removed. Some jack pine and some small white pine still remain. Chestnut and chestnut rock oak furnish a luxuriant half-grown crop, probably ten to twenty cords of wood to the acre. Rose Valley must have produced large crops of white pine, as testified by the numerous stump fences. The white pine is so far gone that the plank road from Salladasburg to English Centre is no longer required or maintained. On the road to Salladasburg from Trout Run the ground is poor, but the valleys are fairly well farmed. The hillsides are well covered with young white pine, hemlock, rock, red and white oak. Possibly sixty per centum of the area was cleared. There is scarcely any timber between Salladasburg and Jersey Shore.

Taking the Pine Creek region we may say that at Ramseys there is a narrow valley with high mountains on either side from which the best timber has been taken, but which is now well covered with a growth of yellow pine, white, black and red oak and some chestnut. At Jersey Mills there is but little good timber in sight.

At Slate Run there is quite a town depending on the large saw mills. At Cedar Run considerable white pine is cut, but hemlock predominates. Five miles above Cedar Run there are some farms visible on the mountain, but fire has overrun the untilled country. Two miles farther up Pine Creek young white pine and hemlock appear, and then a desolate fire-swept mountain side. The ground is utterly waste, steep and rocky. Hemlock of small size is cut for the bark. The tannery at Salladasburg uses 6,000 cords of bark a year. This is hauled from ten to thirty miles.

The road from Salladasburg to English Centre lies through a mountain valley. The streams show sign of high freshets. The denuded hills are starting in with a second growth of yellow birch and maple, though there is small promise that they will escape the annual fires and mature into anything of value.

Between Brookside and English Centre there are some fair farms, but the ground is thin. One mile east from English Centre there is a body of several hundred acres of virgin hemlock,

which is kept in reserve by the tannery trust. Besides this lot there is but little young white pine and no young hemlock visible from English Centre. The ground from Salladasburg to English Centre, though rough and hilly, would much of it do for agriculture, but it is thin, hard to work and would soon wear out. Owing to its steepness it will always be of more use in timber. Leicester tannery, at English Centre, uses 10,000 cords of bark yearly. This bark is hauled six miles. The tannery estimates that it has on hand from 75,000 to 100,000 cords within ten miles.

In the spring of 1894 there were run down Little Pine creek 25,000,000 feet of timber. The maple and birch of this section has been destroyed by fire. The timber is practically all gone along Little Pine creek for six miles above English Centre. Then we come into virgin hemlock, which is being cut (in 1894), and into which a plank road ran. There never was much white pine in this immediate district. About Wolf Run and Boatmen's Branch the land has not only been "skinned," but fire has made sad havoc. Owing to the stony character of the soil it would be difficult to produce any kind of crop.

Mr. Abraham Meyer, of Cogan House (Lycoming county), estimates for the county that there are still about 200,000 acres, in large tracts, which includes the virgin forest, woodland and second growth. It is safe to say that a little less than one-half of this area is in virgin forest, hemlock being the predominating timber, well sprinkled, however, with white pine, hard and soft maple, white, yellow and black birch, beech, bass or linnwood, white ash, poplar, rock, red and white oak. The largest areas of this virgin forest are located as follows. On Slate and Cedar runs, in Brown township, adjoining Tioga and Clinton counties, about 7,000 acres; Little Pine creek district, in McHenry, Pine and Cummings townships, about 34,000 acres; Lycoming Creek district, in McIntyre and Jackson townships, about 34,000 acres; Larry's Creek district, Cogan Valley, in Cogan House township, about 10,000 acres. There also remains some virgin forest in West Branch Valley, Loyalsock Creek district, and along the Bald Eagle mountains. These forests will not remain standing very long, however, as they are being cut at the rate of not less than twenty million feet annually.

The second growths are mostly scrub oak on the ridges, and chestnut and oak on the side hills, with a sprinkling of sap pines, beech, birch and maple on the lower benches. These second growth tracts, if properly cared for, and fires kept out of them, would be most valuable tracts of timber in the future, but with the number of fires that each year are so prevalent in the county, their growth is very much retarded and they become stunted and imperfect.

McKean county:

Entire acreage estimated by geological survey,	640,000
Entire acreage estimated by assessors,	644,000
Acres in hemlock, 12 per cent.,	76,530
Feet in hemlock,	706,700,000
Acres in pine, 0.7 per cent.,	432
Feet in pine,	3,860,000
Acres in hardwood, 25 per cent.,	161,300
Acres in brush, slashings and waste land, 45 per cent.,	292,218
Acres in improved land, 18 per cent.,	114,000

"Trees that grow best are oak, hickory, pine, poplar and beech."

***Mercer county:**

Entire acreage estimated by geological survey,	422,400
Entire acreage estimated by assessors,	398,647
Acres in cleared land,	359,481
Acres in timber land,	39,166
Proportion of timber land to whole (per cent.),	9.8

"Trees that grow best are oak, chestnut, pine, hemlock, ash, beech and maple.

"High and gravelly soil for oak and chestnut; low clay and sand for hemlock and maple."

Mifflin county:

Entire acreage estimated by geological survey,	243,200
Entire acreage estimated by assessors,	273,671
Acres in cleared land,	146,402
Acres in timber land,	127,269
Proportion of timber land to whole (per cent.),	46.5

Remarks:

Leaving McVeytown, as one nears the slope of the Licking Creek mountains the sand stone rocks give character to the surface, and they predominate until one reaches the bottom of the Licking Creek valley, where there is a narrow belt of land rich enough for agriculture. Passing in a southwesterly direction over the Black Log mountain we descend into the Black Log valley, the southeastern boundary of which is Shade mountain. This region of land is twenty-five miles long by three wide.

On an area of seventy-five miles fully nine-tenths is good for nothing else than the growth of timber. Rock oak, chestnut, locust and a small growth of pitch pine prevail on the higher part, and white

pine, white oak and a good-sized growth of pitch pine were on the lower ground. Wherever the merchantable timber is reasonably accessible it has been culled out. Much of the black oak has been cut for the bark, and much of the best white oak has been felled for the butt alone. The hickory, which is more abundant on the southern slopes, is coming into demand for wagon spokes. It is of the best quality. The tree that furnishes the wood is locally known as the "pignut" and has grown to an average diameter of one foot and a height of fifty feet.

Much of the soil is sandy from the disintegration of the prevailing rocks. On this almost the only tree is the pitch pine, which attains a height of ninety feet and a maximum diameter of three feet. There is no tree of more actual value to the State than the pitch pine, because of the wide range of conditions under which it will thrive.

The Black Log is a narrow valley with an average width of three-fourths of a mile, giving scant support to the farmers. A wild black cherry tree found here measured two feet eleven inches in diameter four feet from the ground. The valley is about one-half in fair timber among which was much good shell-bark. White oak and sugar maple are abundant and there are also a few small black walnut trees. Agriculture is poorly remunerated, owing to the trouble of reaching a market. Grazing would doubtless be a more profitable industry. One-sixth of the timber on the northwest slope of Shade mountain has been destroyed by recent fires. Abandoned houses and farms indicate a decreasing population.

The timber growing on Black Log ridge and mountain is rock oak, white oak and some hickory and yellow pine. The average value of the rougher part can not be more than \$1 per acre.

The land of the Upper Licking Creek and Black Log Valley is most important to the State for the timber it will produce. The woodland at present is worth not more than one dollar per acre. Floods usually occur in spring, but the damage is not great, as the delivery is slow and the whole country a wilderness. Sawmill dust has exterminated most of the brook trout in Licking creek.

It is stated by the geological survey (Geological Hand Atlas of Counties, page lxxvii), under Mifflin county "between this eastern mountain line and Jack's mountain (Shade and Blue Ridge) runs the Lewistown Valley, with great regularity, thirty-eight miles long and six miles wide, a trough deeper at its two ends and shallower midway."

This valley is about three-fifths of the entire county, and while its ridges are for the most part clad with timber, and the flanking lower lands contain much scattered woodland, yet its value in timber is mainly prospective, as the wood has been so thoroughly culled out that nearly all the heavy frame timber is brought from a distance for the greater part of this valley.

Through the middle of the (Lewistown) valley, practically for its entire length, there runs a series of ridges. As a whole these ridges are dry, but produce good crops of wheat, corn, oats and clover, except in season of unusual drought. Timber of fair quality grows well on them, and at present one can hardly regard agriculture as less important than the growth of trees, except where, owing to the steepness of the slopes and the tendency to wash out, farming operations are unprofitable. On the other hand, it cannot be denied that the fertility of the soil is rapidly washed out on such ridges, and that its fertility would be retained if the hills were timber clad. There are many acres on these ridges that have lain practically unproductive for forty years, which should by this time have been covered with a growth of nearly matured timber.

The charcoal furnaces of earlier days not only caused the removal of the timber, but the fires resulting from the coaling operations were a frequent cause of conflagrations. Where the sandstone outcrops, or where its disintegration has furnished sand soil, rock oak, black oak, chestnut, hickory, locust, white and pitch pine, with some pin oak and prickly pine (*Pinus pungens*) predominate on the wooded parts. The chestnut practically disappears from the limestone outcrop. Over a considerable portion of these ridge lands there is a vigorous growth of young chestnut, which now is in demand for telegraph poles (from thirty to fifty feet long), which sell for fifty-eight cents on the average on the ground. These poles are from six to seven inches in diameter at the top. Those that are from seven to eight inches in diameter at the top average ninety-five cents apiece. On the average there are forty poles to an acre.

From Hope Furnace toward Decatur township these ridges become more productive, unless washed out. If kept up they produce good crops.

The average height of the ridges above tidewater is about one thousand feet. Reduced to regular shape, the irregular area in Mifflin county embraced within the sand and limestone ridges in the Lewistown valley would be two by thirty-eight miles, an area of seventy-six square miles, of which one-fifth is occupied by forests, making something over fifteen square miles. In addition to the timber and farming possibilities, they contain valuable deposits of hematite and fossil iron. White pine may be regarded as a possible crop over most of these fifteen miles. Black walnut is small, though fairly abundant.

The mountains forming the eastern and western flanks of the limestone valley are in general character of timber like the Licking Creek mountain. For a distance of fourteen miles from Lewistown to the Snyder county line along Jack's creek there is but little timber either in the valley or on the mountains, which have been largely cut over.

Chestnut is the predominating timber, and rock oak comes next. A great number of railroad ties have been and are being cut. Bark has been extensively removed. Nothing of the original growth remains. Observation shows that the timber may be counted on to mature large enough for most commercial purposes in fifty years. The Blue Ridge will not here average more than thirteen cords of wood per acre, and for construction purposes, other than mine props, it will not average above 600 feet board measure to the acre.

The land in the Havice and Triester valleys, in Armagh township, is valuable, but becomes poorer going east. The wood land in Havice valley, embracing ten miles, has an average of ten cords of wood to the acre of various kinds. Mine props are now being largely removed.

Triester valley is two miles wide at its mouth, narrowing to a point seven miles below. It has been mostly cut over, but there is much young timber coming on. The land is three-fourths clear towards the mouth of the valley. Towards the head it becomes less and less cleared until at the head it is practically unsettled. Saw-mills are at work and tram roads come in from the Lewisburg and Tyrone railroad. The mountain sides of this valley contain considerable timber of small size, mainly jack pine, rock oak, chestnut and locust. Within the limits of the valley there are fifteen square miles of wood land, averaging possibly fifteen cords to the acre.

Havice, Triester and New Lancaster valleys are narrow troughs embracing together possibly twenty square miles of land, more or less susceptible of cultivation with promise of scanty crops. Taking in all the mountain exposures southwest from the county line to the mouths of these valleys we should have thirty square miles, making the entire area fifty miles. Over the entire area of thirty miles, that of timber fit to be cut, except for mine props, will not exceed fifteen cords to the acre, if it will do that. The remainder of the Kishocoquillas valley, to the southwest, contains eighty square miles of valley land, nine-tenths of which is under cultivation. The mountain sides of this part of the valley will aggregate forty miles of area. On this most of the timber is young, the older crop having been removed for charcoal and local wants. The young timber appears to be in a vigorous condition and fires are less frequent than in the Licking Creek region.

The Seven Mountains were well covered with timber, although they have been culled over so often that the merchantable timber has become "kind of scattering." It will doubtless be exhausted in ten years. The greatest part of it, pitch pine, is now cut for mine props. At least 1,000 acres have been recently burned over. The dead standing trunks show how severe have been the ravages of fire in former years. Many hemlock trees have been felled for their

bark along the old pike from the Po valley across to Havice valley, and now lie in decay as a reproach to our wasteful methods.

Monroe county:

Entire acreage estimated by geological survey,	384,000
Entire acreage estimated by assessors,	249,779
Acres of cleared land,	110,897
Acres of timber land,	138,882
Proportion of timber land to whole (per cent.),	55.6

Remarks:

Jackson township is said to contain most of the timber of the county. Along the flats from Stroudsburg to Analomink the ground is fertile, but on the hills it is very poor, and yellow pine seemed to be the chief product. The shad bush (*Amelanchier*) frequently attains a foot in diameter and is common on the slaty hillside. The whole region bears the impress of being a remnant of the glacial period.

At a sawmill in Bushkill (near the Pike county line) the ages of some logs were counted with the following results.

Yellow pine,	120 rings, 17½ inches in diameter.
Yellow pine,	120 rings, 21½ inches in diameter.
Yellow pine,	180 rings, 18 inches in diameter.
Black oak,	130 rings, 24 inches in diameter.

The period of maximum growth of the pine was from forty to fifty years.

In Coolbaugh township there are still some lumbering operations of hemlock and spruce.

Across the immediate valley of the southeastern slope of the Pocono knob there is a fairly well cultivated region, but to the north at least eighty per cent. of the country is wooded. Most, if not all of it, has been cut off at least once.

The line of the railroad from Wilkes-Barre to Stroudsburg was once a well-wooded country, but from which most of the matured timber has been taken. It will be twenty-five years before a second crop of importance can reasonably be expected, even if the forest fires are kept out.

In going from Stroudsburg to Wilkes-Barre, attention may be called to the fact that along the line of the railroad, where the fires occur every year, they are never hot enough to destroy the timber. Hence there is a good growth of young timber. Mr. Isaac D. Case, manager of the Tobyhanna mills, a gentleman of large practical experience, believes that firing the woods each spring should be done as early as possible in suitable weather, by proper authorities. He contends that it would kill but little timber and effectually prevent

the spread of damaging fires. At this time (May 14, 1894), there are in the woods about Tobyhanna mills more than a hundred men engaged in fighting fires. The whole horizon is darkened by the smoke and probably not less than 225 square miles (Mr. Case said 400), of the country are being swept by the flames. Yearly burning would doubtless prevent destructive hot fires. What effect it would have on the fertility of the soil is a question.

The Tobyhanna and Lehigh Lumber Company has 40,000 acres of woodland. Of this not more than 1,000 remain in the original forest. This will scale (it is said) 10,000 feet of hemlock to the acre, and 10,000 more of spruce and hardwood. The manager of this company estimates that the constantly recurring fires since 1872 have cost the company not less than 150,000,000 feet of lumber. The yearly output of the mills has been, of hemlock, 10,000,000 feet; of spruce, 5,000,000 feet; and of hardwood, 2,000,000 feet, manufactured into clothes pins, etc.

Montgomery county:

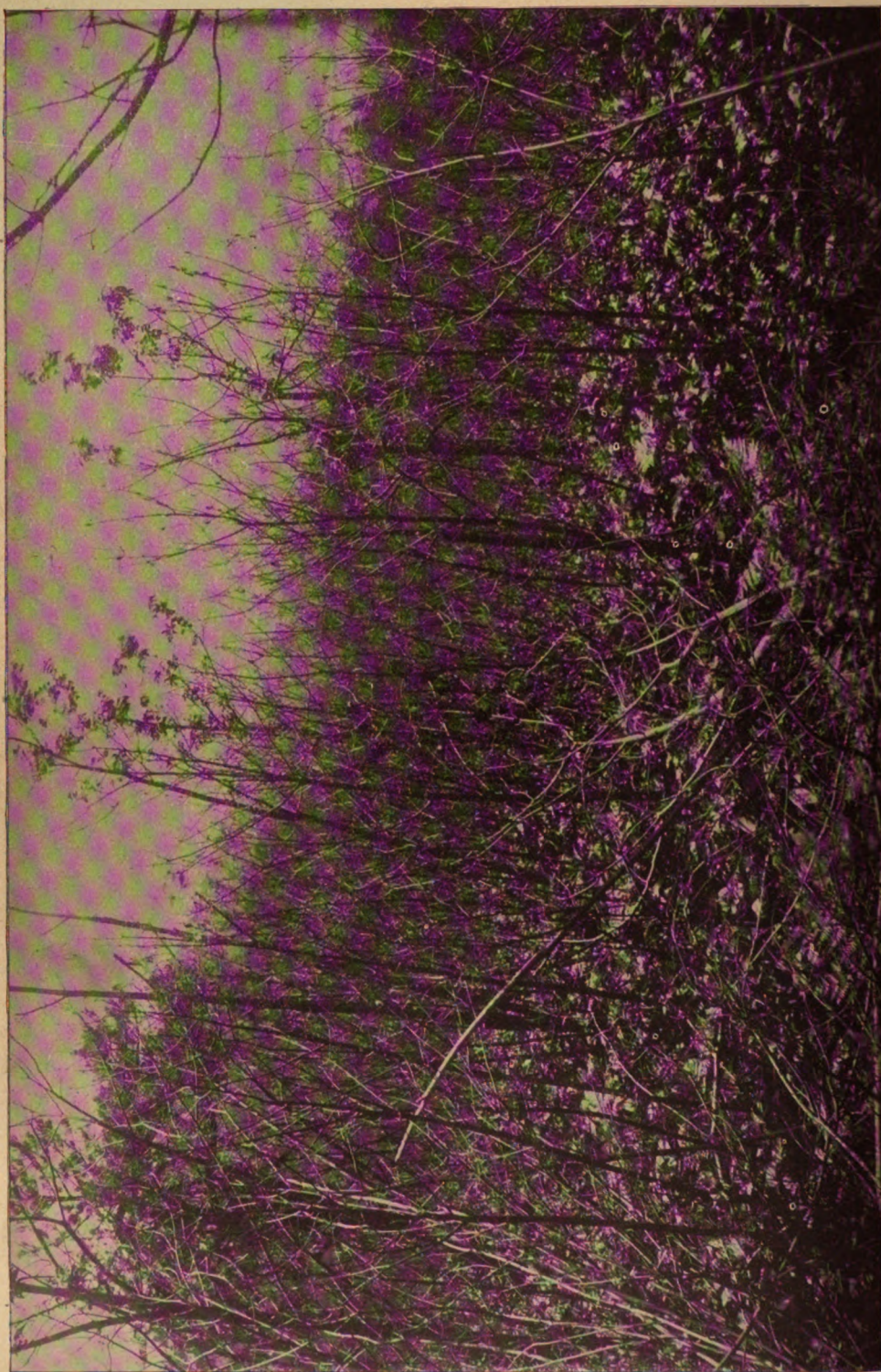
Entire acreage estimated by geological survey,	307,200
Entire acreage estimated by assessors,	281,589
Acres of cleared land,	270,012
Acres of timber land,	11,577
Proportion of timber land to whole (per cent.),	4.1
"The trees that grow best are white oak, black oak, oak and chestnut.	
"Slate hills are best for chestnut; clay soil for oaks."	

Remarks:

From Perkiomen Junction to Schwenksville, along the Perkiomen, the country is wholly of an agricultural character. Not more than ten per cent. of the county is covered with trees, and that very sparsely. These are measurably good, most matured. There is some little pin oak, red oak and rock oak, but so little as to scarcely attract attention. There seems to have been no attempt at tree planting, save here and there along the road sides.

The county is richly agricultural between Schwenksville and Perkiomenville, not more than one-fifteenth in timber until we reach the ridges in New Hanover, Marlborough and Upper Salford townships. In that section is an unusual quantity of thrifty red cedar. There is some fair white oak, though not of the first-class. Chestnut is common, though none of a large size.

Montgomery county, like the adjacent counties, is essentially agricultural. The land is fertile and too valuable to devote, at least for the present, to forestry purposes. It should be stated, however, that no more zealous or efficient advocate of forestry can be found in the State than Hon. B. W. Dambly, of Skipack.



(Plate 45.)

Young Chestnut Timber, Killed by Fire. It will Furnish Fuel to Destroy the Succeeding Crop of Sprouts. Luzerne County.



(Plate 46.)

Fallen Hemlock, Caused by Cutting off the Roots to Open a Road. Sullivan County.

***Montour county:**

Entire acreage estimated by geological survey.	98,600
Entire acreage estimated by assessors.	74,258
Acres of cleared land,	59,629
Acres of timber land,	14,629
Proportion of timber land to whole (per cent.),	19.7

"Trees that grow best are oak and chestnut.

"Gravel is best adapted for chestnut; clay for white oak."

Northampton county:

Entire acreage estimated by geological survey,	243,200
Entire acreage estimated by assessors.	212,317
Acres of cleared land,	190,216
Acres of timber land,	22,101
Proportion of timber land to whole (per cent.),	10.4

"Trees that grow best are white oak, black oak, rock oak, chestnut, hickory and black walnut.

"Clay and limestone are best for white oak, hickory and walnut; gravel and slate best for walnut, pine and maple."

Remarks:

The Lehigh hills are sparsely wooded with white and red oak and chestnut. From these hills to Nazareth (eleven miles), is a rich agricultural region. To the north are the Blue Mountains, which have a scanty covering of inferior timber. To the south of this range not one-fifteenth of the country is in timber. In the oak woods there is not more than 2,500 feet B. M. on an average.

Between Nazareth and Wind Gap the country for six miles is of an agricultural character. Near Nazareth it is very fertile. The crossing of the Bushkill (in Northampton county) marks the dividing line. The land becomes poor and much of it is in timber. The first white birch appears between the Bushkill and Wind Gap P. O. Some white pine in clumps is found here and there, and young hemlock a foot in diameter covers the damp hillsides. Timber was mainly white oak from Nazareth to the Bushkill, with occasionally shell-bark and walnut; from the Bushkill to Wind Gap, chestnut, with occasionally red oak. The sides of the Blue mountains have some rock oak and chestnut, but not more than 1,500 feet to the acre. Some business is done in railroad ties—of white and rock oak and chestnut. Occasionally there are large chestnut and tulip-poplar trees, but the red cedar plentiful in the southeastern part of the county is here wholly wanting.

***Northumberland county:**

Entire acreage estimated by geological survey,	294,400
Entire acreage estimated by assessors,	244,774
Acres of cleared land,	192,886
Acres of timber land,	51,888
Proportion of timber land to whole (per cent.),	21.2
"Trees that grow best are white oak and chestnut.	
"Uplands are best for chestnut; side hills for white oak and hemlock-spruce."	

Remarks:

The portions of Montour and Northumberland counties traversed are rich agricultural regions. There is hardly a forest large enough to be represented on a scale of six miles to the inch. Black walnut is the most common open ground tree. White oak, black oak, rock oak and swamp white oak are most common in the woods. There is considerable pitch pine on the higher grounds, and some red maple on the lower.

Perry county:

Entire acreage estimated by geological survey,	307,200
Entire acreage estimated by assessors,	308,487
Acres of cleared land,	147,978
Acres of timber land,	160,509
Proportion of timber land to whole (per cent.),	52
"Trees that grow best are white oak, rock oak, hickory, black walnut and locust.	
"Gravel and limestone are best for walnut, chestnut, oak and locust; bottom lands for hickory."	
Large quantities of black walnut have recently been shipped from this county.	

Remarks:

In going across the country from Sterrett's Gap via New Bloomfield to Ickesburg one finds some good farming valleys, but the higher grounds are in the main poor, often with a scanty growth of timber. There are some fine farms near Landisburg. There is considerable pitch pine remaining on the mountain; some small white pine on the hills associated with rock oak, chestnut, black oak, red oak and some white oak, with cherry birch on the highest ground. The average per acre in the wooded part will not aggregate 2,000 feet B. M. Near Wagner's or Long's Gap much of the timber is of a vigorous second growth, chestnut and red oak. Apparently it has been cut off to supply charcoal for a formerly existing furnace, as the old coal hearths testify.

Philadelphia county:

Entire acreage estimated by geological survey,	83,200
Entire acreage estimated by assessors,	83,000
Acres of cleared land,	80,000
Acres of timber land,	3,000
Proportion of timber land to whole (per cent.),	3.6
Practically no forests.	

Pike county:

Entire acreage estimated by geological survey,	403,200
Entire acreage estimated by assessors,	346,887
Acres of cleared land,	28,231
Acres of timber land,	318,656
Proportion of timber land to whole (per cent.),	91.8

"Trees that grow best are various oaks, chestnut, pine, white and yellow hemlock, black spruce, beech and maple."

Remarks:

Fires are the very curse of the county. The abandoned homes lead to the conviction that the region is decreasing in population, and the soil promises but little after gaining the highlands in the way of agriculture. The tannery at Resaca, now abandoned, having used most of the hemlock, and but little oak remaining, the lumbering, about the only business of that region has disappeared. The Falls of Resaca are larger so far as the volume of water is concerned than the Bushkill Falls, but the latter have a single pitch of 85 feet, while those of Resaca hardly exceed 50 feet. Iona Falls are a succession of short pitches. The falls are impressive. Those of Resaca are least so, as the county has been cleared and the falls stand in the midst of an open grassy plat, whereas those of Iona and Bushkill are still in a wilderness. (See frontispiece).

From Bushkill to Dingman's Ferry, the road is between the river and the shaly, poor, steep ridge. Toward the river from the road is a narrow belt of fertile land under good cultivation. At Dingman's Ferry, on Mr. W. E. Adam's farm, is Townsend's swamp, which has some interesting features. It is about 300 acres in extent. Sixty years ago the swamp was cut clean; twenty-five years ago the ground was timbered over again, and to-day the pine will average 6,000 feet to the acre.

There is considerable young larch, and much black spruce in this swamp. The spruce seems to be invading the pine area. As a curiosity the writer saw a decaying white pine stump, two feet

across, on which there were thirty young spruce trees, from two to eighteen inches high, all well started. The maximum size of the spruce was fifty feet high and fourteen inches across the stump. The soil in the swamp is so soft that it is quite possible to stick a thin pole ten feet into the soft, black mud.

White birch has risen in the cold swamp to a tree thirty feet high, and six inches through. Ash is abundant in the damp woods. The black walnut and shell-bark are confined to the lower grounds, but the butternut is frequent and grows to a height of thirty or forty feet. The county has been all cut over; some of it a century ago. There is much young chestnut coming up as sprouts. If fire could be kept out for fifty years, the value of this region would be restored; now it is being depopulated.

In going from Dingman's Ferry to Blooming Grove the most striking feature is the abandonment of farms by the wayside in Dingman township. There are no signs of prosperity until we reach Blooming Grove township. There were acres of pitch pine that would scale 8,000 feet of merchantable lumber to the acre. In the lowlands, white pine of twelve to sixteen inches in diameter is common. Moderate sized spruce is associated with it, but not exceeding twelve inches in diameter.

Near the Blooming Grove Club House is a small lake which is well stocked with trout, none less than four years old, from the hatching being put into the lake. This insures their protection against the pike and black bass. Blooming Grove in its eastern half is almost an unbroken forest, thirty per cent. of which is pitch pine.

No county can better illustrate the folly of attempting to find home fire wardens. These should be appointed from other regions, not from their home districts. From what was seen, it is fair to infer that in Dingman and Blooming Grove townships timber thieves are very busy. Probably they are not less active in other parts of the county, where the soil is poor and the population sparse. It is the only visible means of support for some of the people. The great staple appears to be pitch pine.

At Ledgesdale in the valley of the Wallenpaupack the large tannery had been burned down and the company seemed to be simply working up the stock on hand. Near the tannery, the hemlock had been cut and peeled and the trunks allowed to remain on the ground, probably to be run down the stream to the mills below. Probably one-fourth of the country on the Pike county side of the valley is cleared. The low grounds are fertile.

Potter county:

Entire acreage estimated by geological survey,	684,800
Entire acreage estimated by assessors,	678,890
Acres of cleared land,	132,425
Acres of timber land,	546,465
Proportion of timber land to whole (per cent).	80.4

"Trees that grow best are oak, chestnut, pine, hemlock, ash, beech and maple."

Remarks:

Miss Anna Bodler, superintendent of public schools in Potter county, kindly furnished the following statistics relating to the lumber interest of that county:

"Fifty saw mills.

Five hundred million feet B. M. annual output.

Twenty-six thousand acres cleared annually for the above.

Thirteen thousand five hundred acres cleared annually for bark.

Fifty thousand cords annual production of bark.

One hundred and fifteen acres cleared annually for charcoal.

Two hundred and fifty-two thousand bushels of charcoal produced annually.

One hundred and seventy-five acres cleared for railroad ties and sundries.

Six years after land is cleared it is covered with young trees twelve feet high.

The different kinds of lumber are maple, cherry, ash, chestnut, birch, beech, basswood, white pine and hemlock."

In the valley of Pine Creek there is little timber in sight. The hills are denuded of everything but hardwood. There is a narrow strip of farm land in the valley. Three miles east of Brookland is a region where the hemlock is vigorous. At Brookland we find the country opening up. Towards Ulysses there is more farm land.

Three miles east of Sweden Valley following the pike along the divide, we find the summit well covered with a dense growth of hardwood; sugar maple of large size, yellow birch, some cherry and black birch. The ravine on either sloping at right angles to the pike contains a dense growth of fine hemlock.

Between Coudersport and Oswayo the hills are covered with sugar maple, beech and yellow birch, these occupy almost fifty per cent. of the whole area. The valleys are generally well cultivated.

At Oswayo there is a large tannery, which when in full operation uses about 10,000 tons of bark annually. The hills around are stripped of hemlock. Bark is sometimes hauled a distance of twelve miles. The usual haul is from five to seven miles. This region has

been one of pre-eminent pine production. The white pine is now all gone, and almost none coming on. The stumps remaining indicate the size and number of the white pine trees that once stood on the soil. There are twenty to thirty-five stumps per acre, averaging from two to four feet across. Five feet was not unusual, and trees of seven feet have been taken to the mill from this county. As a farming country, the ground from which the white pine came was fair; it was not the best, nor by any means the worst.

On the divide between the Allegheny river and the Sinnemahoning waters the road from Coudersport to Austin passes through a hemlock and hardwood forest, where the hemlock probably averages 10,000 feet to the acre. From this point across to Austin the hills are absolutely denuded. The land except just near Odin is too poor for farming purposes. The mill at Austin is doing a large business cutting up the hemlock. The bark goes to Costello.

A new mill at Cross Fork Junction (just on the Potter county line and in Clinton county) now in operation is capable of cutting 150,000 feet in eleven hours. It is claimed that there is three hundred million feet of hemlock at Hammersley Fork, four miles below.

Along the slopes of the Sinnemahoning water, from Costello to Cross Forks, there was a heavy growth of hemlock and pine. Mixed with it was the usual sugar maple, beech and yellow birch and some small cherry. About one-half of the land in sight has been already stripped. The remainder will probably average 10,000 feet to the acre.

***Schuylkill county:**

Entire acreage estimated by geological survey,	537,600
Entire acreage reported by assessors,	231,314
Acres of cleared land,	181,691
Acres of timber land,	49,623
Proportion of timber land to whole (per cent.),	21

Remarks:

There is really but little good timber of any kind remaining in this county. What is classified as such above is for the largest part merely a "scrub growth" of no great value.

The following reports from Mr. Geo. E. Kirkpatrick, superintendent of the Girard estate will explain themselves. They are object lessons of great value to the State. It is a pity that at the same time a larger number of species had not been tested for rapid, certain growth and for general utility as forest producers.

Extracts from report of Heber S. Thompson, engineer Girard estate, for the year ending December 31, 1894, made on that date to the Board of Directors of Philadelphia City Trusts.

Forest Culture. Sixteen thousand young trees were set out on the watershed of the reservoirs of the Girard Water Company this year, as follows: 6,000 European larch, 2,500 *Catalpa speciosa*, 2,500 wild black cherry, 2,500 Scotch pine, 2,500 white pine.

Twenty thousand young trees have been ordered for planting in the spring of 1895, viz: 10,000 European larch, 8,000 Scotch pine, 1,000 *Catalpa speciosa*, 1,000 wild black cherry.

The whole number of trees planted to this date is 169,150 as follows:

In 1881,	850 seedlings.
In 1882,	2,300 "
In 1885,	1,000 "
In 1887,	2,000 "
In 1888,	10,000 "
In 1889,	22,000 "
In 1890,	20,000 "
In 1891,	30,000 "
In 1892,	45,000 "
In 1893,	20,000 "
In 1894,	16,000 "

Total, 169,150

A recent examination of the 153,150 planted from 1881 to 1893, and estimate of the present number, shows about 65,260 or 42 61-100 per cent., now growing, from an average of half an inch in diameter and two feet high, planted in 1893, to an average of six inches in diameter and thirty-two feet high, planted in 1881. The largest of the larches planted in 1881 are ten inches in diameter and thirty-five feet high. The largest *Catalpas* planted in 1881 are eight inches in diameter and thirty feet high. When planted in 1881 these trees were seedlings about three inches in length. The largest Austrian pines planted in 1882 are seven and a half inches in diameter and nineteen and a half feet high.

Forest fires, the chief enemy of forestry, have been started several times during the past year by ignorant trespassers in the area inclosed for forest culture, but were discovered in time and extinguished before doing serious damage. Avenues have been cleared around and across the ground devoted to forest culture by cutting on both edges of a fifty feet wide avenue, throwing the cut brush inwards and burning it over at a convenient time and with proper precautions to prevent the spread of the fire. The personal presence of forestry inspectors, who will watch and patrol the lands set apart for this purpose, and the measures they can adopt to prevent and extinguish fires, seem to be absolutely necessary to successful forestry, and more particularly in a new country, where there is in the minds

of foreigners a disposition to disregard all forestry laws as well as other good laws, in the natural rebound from the irksome restraints of laws, sometimes good and sometimes unreasonably severe, to which they have been accustomed in the old countries of Europe. Our present forestry experiment is too small to afford this personal presence and patrol, but when the estate enters upon the work of forestry in a large way, which it must and will before many years, having thirteen thousand acres of farm and mountain land barren of coal, which, under the terms of Mr. Girard's will, cannot be sold and is adapted only for forest culture, the work will warrant the permanent employment of men specially trained in forestry.

Extract from the report of Heber S. Thompson, Esq., engineer Girard estate, for the year ending December 31, 1895, to the Board of Directors of Philadelphia City Trusts.

Forest Culture.—Twenty thousand young trees were planted in April of this year on the water-shed of Lost Creek within the fenced area leased to the Girard Water Company. The varieties were as follows :

- 10,000 European larch.
- 8,000 Scotch pine.
- 1,000 *Catalpa speciosa*.
- 1,000 black wild cherry.

They were healthy shoots from one to two feet in height and cost \$75.00 a thousand or three-quarters of a cent each.

The remarkable drouth which has prevailed from month to month uniformly from the beginning to the end of the year has caused the loss of a large number of the trees planted this year. Forest fires have run over some parts of the estate but have been kept out of the forest preserve of planted trees.

Forest Preserve No. 1.—A section of mountain land containing 1,200 acres has been set apart as a forest preserve upon which young oak, chestnut and pine timber springing up simultaneously will be protected and preserved. A contract has been let and partially completed for the cutting out and burning over of a fire road 100 feet wide around this preserve, connecting with the township roads and making with them a barrier against the entrance of fire into this preserve.

Private roads running through the preserve will assist to confine a fire which may find entrance to a portion only of the preserve. This forest preserve No. 1 lies upon the Edward Lynch, James Howell, Israel Cope and Thomas P. Cope tracts and covers all the reservoirs of the Girard Water Company and the water-shed of Raven's Run and Lost Creek streams flowing into them. A forest patrol of three men is now employed on Sunday and on all holidays to patrol this preserve and other timber lands of the Girard estate

to prevent the starting of forest fires, to extinguish them when they are discovered and to protect the growing timber from injury by lawless persons.

***Snyder county:**

Entire acreage estimated by geological survey,	204,800
Entire acreage estimated by assessors,	203,833
Acres of cleared land,	132,745
Acres of timber land,,	71,088
Proportion of timber land to whole (per cent.),	34.8

"Trees that grow best are oak and chestnut.

"Light soil best adapted for chestnut; heavy for oak."

In the northern boundary of the western half of this county there is considerable rough land and consequently some forest. It produces now chiefly yellow pine for mine props. Here and there considerable quantities of black walnut might be produced, especially along the limestone outcrops.

Somerset county:

Entire acreage estimated by geological survey,	704,000
Entire acreage estimated by assessors,	560,802
Acres of cleared land,	284,809
Acres of timber land,	275,993
Proportion of timber land to whole (per cent.),	49.2

"Trees that grow best are oak, chestnut, hickory, pine, hemlock, sugar maple and elm.

"Soil best adapted is clay for oaks, sandy for chestnut, wet and sandy for pine."

Somerset county contains, probably, the highest point of the State; a spur of Negro mountain, Keyser's Ridge Summit, being said to be 2,843 feet above tide. This is probably correct within a few feet. The general surface of the county is high, hilly and cut from north to south in its southeastern half by the main chain of the Alleghenies, by Savage mountain and Negro mountain, while Laurel Hill, on the west, divides it from Fayette and Westmoreland counties. It is admirably adapted to the grazing and dairy interests, but also, in spite of its altitude, includes much good grain producing soil. Originally it contained much good white pine. This is practically gone now. There is considerable fine hemlock within its limits, and especially in the region adjacent to the western slope of the main Allegheny chain, but is so scattered that it would be extremely hard to make even an approximate estimate of its quantity. On the steeper slopes there still remains some rock oak. It is how-

ever, fast being removed to furnish bark for tanning purposes. The remaining white oak, of which this region once possessed a large quantity, and of good quality, is now being used up for ties. *Quercus imbricaria*, the "laurel or shingle oak," is very sparingly represented in Somerset county. The commonest tree there is the sugar maple, and the quantity of sugar and syrup made places this county among the first maple sugar producing regions of the United States. It is a matter of great regret that exact information as to the quantities produced was not furnished by the officials of the county in time for insertion here.

Forest fires do not seem to have been as bad here as in some other of the timbered counties. As usual, however, the mountain top shows the most marked signs of it.

Jack and yellow pine are by no means common in Somerset county; and when found are apt to be on the highest, roughest and poorest parts of the county.

Sullivan county:

Entire acreage estimated by geological survey,	275,200
Entire acreage estimated by assessors,	277,288
Acres of cleared land,	124,608
Acres of timber land,	152,680
Proportion of timber land to whole (per cent.),	55
"Trees that grow best are chestnut, pine, hemlock, ash, beech and maple, birch (yellow and black) and wild black cherry.	
"Soil best adapted is dry rolling ridges for hard wood; low and murky for hemlock."	

Remarks:*

The red spruce of this region is almost all on Mehoopany waters. It is dying from an attack of fungus, probably. It is estimated that in parts of Luzerne, Wyoming and Sullivan counties adjacent to each other there are 50,000 acres of hemlock. The Union Tanning Company has a fine tract of hemlock near Jamison City, in Columbia county. In Forks township it has between 13,000 and 15,000 acres, which is estimated to produce seven cords of hemlock bark to the acre. On the Lycoming county border there is a similarly timbered area. The mills at Lopez have cut most of the valuable timber, and this condition of affairs exists up to the head waters of the South Branch of the Loyalsock. (See plate 46).

* Since writing the above we have gained some additional facts, in relation to Sullivan county. Area of the county is given at 277,600 acres. Of standing hemlock, about 50,000 acres, and of standing hardwood scattered through the hemlock, on hills and ridges, about 63,000 acres. There are probably about 611,000,000 ft. B. M. of hemlock, 25,000,000 of pine, 32,700,000 ft. of spruce; and of the hardwoods (oak, poplar, maple, chestnut, cucumber, cherry, birch, beech, basswood and ash) about 590,000,000 feet.

The region named Bella Sylva, on the maps, in Wyoming county, was settled by a colony of Germans, who worked their way up many years ago from the valley of the North Branch. There is some little good land, but most of the farms are impoverished and practically abandoned. There is still some bark being removed. In this and adjacent counties the region of the Pocono sandstone is now recognized as the timbered part.

Susquehanna county:

Entire acreage estimated by geological survey.	531,200
Entire acreage estimated by assessors,	477,816
Acres of cleared land,	319,648
Acres of timber land,	158,168
Proportion of timber land to whole (per cent.),	33.1

In order of abundance the species of trees is: Sugar maple, beech, red maple, hemlock, white pine, white ash, American elm, chestnut, with some hickory, butternut, iron wood, basswood and birch.

Remarks:

Between Clifford and Montrose the surface of the country is very rolling. Yet there is no waste land. Most of the hills have been cultivated to the very top. The more common species of timber is sugar maple. There is considerable butternut, some of the trees being two feet through.

On northern exposures hemlock is the prevailing timber and it is of two-thirds size. There is much ash and elm, but chestnut is scarce. About fifty per cent. of the country is covered by timber which is well grown. Except for the relative absence of white pine, oak and hickory, this county to-day should be self supporting in timber, with what now grows.

Between Montrose and Great Bend there is the same predominance of sugar maple. Beech is less abundant, but there is more red maple. Mr. Searle showed the writer some white pine trees thirty-two years old which he has planted. They are now fifteen inches across the stump. Another instance of rapid growth was where a field was in rye thirty years ago and is now well covered with sugar maple twenty feet or more high.

Passing down Wylie creek to Great Bend, the hills become mountains, with slopes too steep for cultivation. One fact should be noted in connection with the cleared land here, the sward is usually dense enough to prevent serious washes. The relative absence of oak is a marked feature in the forest here. There is some, but it is not common.

The high water at Wilkes-Barre in spring of 1894 was not associated with any high stage of water here. The steep timber-covered

hills, the loose, strong soil and dense sward act efficiently in retaining the water. There is no doubt that the smaller sized stones retard the flow of water and aid in its absorption in the open fields. On the other hand, where the rocks are many and large, the water must run between them and carry away much of the soil.

In the route from Hallstead to Friendsville, the hills become small mountains with steep declivities, not rocky, but quite tillable. Near Franklin we find hemlock of the virgin forest, dead at the top. It should have been cut. In this part of the county there is almost no young hemlock, and but little white pine coming on. The sugar and red maple seem to be usurping the ground as a second crop. Butternut here is more common than black walnut. Fifty per cent. of the northern and western part of the county is in timber, of which most was two-thirds matured. Little wash appears on the surface of the soil. Crops seem fair. The upland scenery here in Susquehanna county is equal to any in the State. There is no waste land apparent, except on the mountains about Great Bend. Almost all the land is capable of cultivation.

About Rushville there is some chestnut, white pine and hemlock, though some of the hemlock is past its prime. An abandoned tannery tells us but too plainly that bark is scarce.

Tioga county:

Entire acreage estimated by geological survey.	716,800
Entire acreage estimated by assessors,	659,574
Acres of cleared land,	400,391
Acres of timber land,	259,183
Proportion of timber land to whole (per cent.),	39.3
"Trees that grow best are oak, chestnut, pine, hemlock, beech and maple.	
"Of soils, mountains for pine; swamp for ash; tableland for maple and beech."	

Remarks:

The Philadelphia Record of August 16, 1894, had a commendatory editorial on a paper by Dr. Guy Hinsdale, in the Medical News, which brings out the fact that the north Pennsylvania plateau enjoys rare immunity from pulmonary tuberculosis. In New York city, one out of every four hundred dies from it. In the Adirondacks, one out of 900, and on the Pennsylvania plateau, one out of 1,330.

From Roaring Branch, in Lycoming county, to Blossburg, in Tioga, the hemlock has nearly all been cut out. It remains only in the ravines. The high ground back is mostly in farms, which are not of

the first quality. From a point half a mile northwest of Ogdensburg to Blossburg is a stretch of mountain which had its hemlock cut off in earlier days, and where now only hard wood remains. Most of this has been destroyed by fire. It is a great field for parties who come into the mountains to pick berries and who cause many of the most destructive fires. It is a question, which in the future is to be of more importance to the State, the berries or the timber. If the latter, then the berry pickers must be kept under control. Fire cherry comes up most commonly after a burning, as it does in the whole region, but is of no use whatever.

Union township is a district of high, poor farms, with ravines along the streams, and until recently was well wooded. In Bloss, Ward and Union townships not over two or three years cut of hemlock is left, and the hardwood is of small importance. Sugar maple and yellow birch are the chief trees. From two miles east of Cherry Flats to Wellsboro not more than 25 per cent. of the land in sight is timbered. It is a high plateau of fairly good farm land.

Mr. D. L. Deane, an active land surveyor of Wellsboro, made a full statement of the forest conditions in Tioga county to the State Forestry Commission, which is here quoted at length.

"Fifteen to twenty years ago we had quite extensive forest areas. Since that time the destroying hand of the farmer and the lumberman has swept our wealth of that character out of existence. Hard on the heels of these destructive forces have followed the forest fires, originating from many sources, and these have largely completed the destruction of the little that the farmer and the lumberman left. Frequent recurrence of such fires destroys the shrubbery growth following the cutting away of the timber, which in time (if not destroyed) would reclothe our now waste mountain areas with valuable woods, and these fires so denude the surface and destroy the fertility of the soil that now in many places no growth of any value starts up. It can hardly be said that we have any forest lands in the country now, by the term 'forest lands,' meaning lands on which the original forest growth is still standing. We have quite extensive areas on which there is still some timber growth, but that which is left is but culls, and of little worth. When all the hemlock and pine and other woods of worth as timber are taken, what is left is but a poor semblance of forest. The winds soon upturn it, or the fires burn it, and in a brief time it is gone and briars and worthless shrubbery take its place. I doubt if there is to-day within the borders of this county more than 30,000 acres of land timbered with unbroken original forest growth. This quantity I mean exclusive of the patches of timber four, five to thirty and forty acres in extent, which still remain on very many of the farms throughout the agricultural parts of the county. Even in these patches of timber generally all the

kinds valuable for lumber have been culled out, and what is left is valuable only for fuel, or for maple sugar production.

"In some places, mainly on the untillable mountain areas, a second growth of valuable kinds of timber has attained to considerable size and would in time reforest the land. Even this growth the greed of the timber hunter has attacked, and instead of being allowed to grow to greater worth, it is being wastefully swept away for railroad ties, fence ties, fence posts, box boards and other uses to which small timber may be put. Our mountain streams, which when the forests were standing, had through all the year a nearly uniform flow, now dwindle in the dry season to mere rivulets, or cease to flow altogether. Springs that then were permanent throughout the year and bountiful in supply, are so reduced in volume as no longer to be a dependence, or are wholly gone. In the season of heavy rains the waters are thrown so quickly to the courses that small streams become raging and destructive torrents, and when aggregated in the larger water courses the waters move with such impetuous force as to sweep the valleys, carrying away not only buildings, but whole farms, and robbing many of the accumulations of a lifetime. Until such measures are taken as will result eventually in reforesting our waste lands we will see a continuance of such, or even worse, conditions, and our legislators and the people generally cannot awaken too soon to a realization of the imperative need of measures looking, not only to the conservation of the forests still remaining, but to the restoration of forest growths on all lands denuded of such growth not reasonably suitable for, or needful for, agricultural purposes."

"Wellsboro, August 30, 1894."

In passing from Wellsboro west towards the Potter county line, there is practically no timber until Ansonia is reached. Not more than twenty per cent. of the region traversed is woodland; this has been culled. From Ansonia up Pine creek to Gaines the region was once well wooded, but most of the timber is now gone, leaving only the cullings. There is a marked tendency for white pine to reproduce itself here. There is some white and red oak, but very little old pine. The white elm grows along the streams.

There is an extensive tannery one mile east of Gaines, which has already denuded most of the hills of hemlock. There is very little hard wood remaining.

Union county:

Entire acreage estimated by geological survey,	198,400
Entire acreage estimated by assessors,	183,378
Acres of cleared land,	98,200



(Plate 47.)

"In the Slashings"—Fuel for the Flame. Union County.



Acres of timber land,	85,178
Proportion of timber land to whole (per cent.),	46.4

"Trees that grow best are white and black oak, chestnut, black walnut, locust and maples.

"Clay bottom is best for oaks; any good soil for chestnut and locust."

Remarks:

The northwestern part of the county has long been the scene of lumbering operations. From the hillsides most of the valuable timber has been removed, and fire has swept over the region in early days, doing serious damage. In the lower half of the Brush Valley Narrows there is still standing a heavy body of hemlock, which is now being cut. The hemlock in this valley might aggregate 3,000,000 feet B. M. (See plate 47).

The whole of the mountain region from western Snyder county and the eastern part of Mifflin county to Lycoming county is of vast importance as a water shed. It has no value except for the growth of timber. From Forest Hill, south of Mifflinburg, there is but little timber. It is mainly hilly, but is good farm land.

From Mifflinburg to the Susquehanna in line with Turtleville, then across the Shamokin mountain to the south, up the valley to New Berlin, is an area of eight miles by two and a half or three miles, which is principally woodland. Shamokin mountain and outlying ranges equal to twelve square miles, average 1,200 feet of merchantable timber to the acre, or 9,216,000 feet B. M. This is made up of white, rock and black oak, jack, yellow and white pine, with chestnut and hickory.

There is also a large quantity of prickly pine, only suitable for mine props. The trees are often fifty feet in height, but seldom more than eight inches through at the butt.

The Shamokin mountain is not rocky, and might be largely cultivated. There is everywhere a growth of timber coming on. From Mifflinburg to New Berlin and along Penn's creek towards Hartleton there are two miles in timber. It is a westward continuation of Shamokin mountain, and timbered like it both in kind and amount. Prickly pine is also abundant. Beyond this region going to the west and north is rich farm land back to Paddy's and Buffalo mountains. In the section of Penn's Valley to Centre county boundary line, the land has been cleared, and there is really little good timber of marketable size, except what remains near the head of the ravines.

The White Deer region, at an early date, had much of its marketable timber removed. There is a body of white pine of middling

quality remaining on the south side of the creek. It may aggregate 1,000,000 feet B. M. The mountain gorge on south side contains considerable hemlock, probably 5,000,000 feet. There is also on the mountain top (south side) 2,000,000 feet possibly, and about the same of rock oak.

Union county, south of a line from Forest iron works to Reish's Hotel, near the Centre county line, is largely agricultural and contains but little timber, perhaps, not more than 5,000,000 feet, chiefly white and black oak. Sand mountain, in Centre and Union counties, has a small area of very fine prickly pine. The white pine on the whole region has been removed. There is, however, much young timber of this kind coming on.

***Venango county:**

Entire acreage estimated by geological survey,	422,400
Entire acreage estimated by assessors,	401,245
Acres of cleared land,	190,741
Acres of timber land,	210,504
Proportion of timber land to whole (per cent.),	52.4

"Trees that grow best are white oak, red oak, chestnut and sugar maple.

"Clay, gravel loam is best adapted for chestnut, oak and other varieties."

***Warren county:**

Entire acreage estimated by geological survey,	582,400
Entire acreage estimated by assessors,	425,165
Acres of cleared land,	283,457
Acres of timber land,	141,708
Proportion of timber land to whole (per cent.),	33.3

Remarks:

From a map marked by Mr. D. F. A. Wheelock, of Warren, and furnished the Commission, the following facts are gathered in regard to the woodlands in Warren county:

Beginning at the northwest part of the county there is a tract of 700 acres of white pine near Bear Lake. Further to the east, in Freehold township, near the New York line, is a small amount of sugar maple. In the same township, near Wrightsville, is a small area of beech, containing perhaps 300 acres. On the line between Freehold and Creek townships is a grove of hemlock, beech and sugar maple. Beech is found in Sugar Grove township, beech and maple in Farmington and chestnut in Conewango.

There is a fine area of 800 acres of hemlock lying in the section bounded on the west and south by the two Brokenstraw creeks, mostly in Pittsfield township.

There is a narrow strip of land ten miles long along the west side of the Allegheny river, in Elk and Glade townships, where there is considerable oak and chestnut. On the east side of the river, in Corydon township, there is a similar belt of hemlock and oak, but less in extent.

As we approach the central portions of the county, the areas of lumber land become larger. There is a tract of 500 acres of hemlock in Spring Creek, one of 2,000 acres, one of 300 and another of 100 acres of the same kind in Eldred.

On the west side of the Allegheny river, extending from the Big Brokenstraw to the Forest county line, is a fine showing of oak, chestnut and scattering hemlock. To the southeast of the Allegheny, extending through Pleasant, Watson and Limestone townships, and partially enclosed by the river, is a region of forest growth equal to any in Pennsylvania. It consists of white pine, hemlock, beech, sugar maple, oak and chestnut.

There is a fine grove of hemlock and beech in Deerfield 600 acres in extent, one of 1,200 acres in South West and another considerable stretch of hemlock in the same township.

In the eastern part of the county, south of the Allegheny, there is a pretty large area of scattering hemlock, mostly in Kinzua and Sheffield townships.

***Washington county:**

Entire acreage estimated by geological survey,	569,600
Entire acreage estimated by assessors,	491,436
Acres of cleared land,	429,450
Acres of timber land,	61,986
Proportion of timber land to whole (per cent.),	12.6
"Trees that grow best are white oak, hickory and poplar.	
"Clay and limestone are best for most thrifty timber."	

Wayne county:

Entire acreage estimated by geological survey,	473,600
Entire acreage estimated by assessors,	426,895
Acres of cleared land,	387,424
Acres of timber land,	39,471
Proportion of timber land to whole (per cent.),	9.2
"Trees that grow best are hickory, elm, white pine, hemlock, ash, beech and maple.	
"Low lands are best adapted for pine and hemlock; high lands for hard woods."	

Remarks:

Passing through Hemlock Hollow from Hawley to Ledgesdale, on the Paupack, we find most of the country cleared; not more than

twenty-five per cent. in timber, much of it chestnut and white oak. Along the Paupack there is some good hemlock in the swamps, with a mixture of white pine, yellow birch, etc.

In Salem township there is about 100,000 feet of large hemlock standing. Another gentleman has some standing in the same township. There is a body of good hemlock three or four miles north of Honesdale. Mr. Lewis S. Collins, surveyor of Wayne county, described the condition of affairs when he said that in 1850 tanneries first came into this region from New York, and that in thirty years they had practically used up the hemlock. One wood acid manufacturer says he uses 3,000 cords of beech, birch and maple in a year. Wood acid factories are said to be the most destructive agencies at work now in the hard wood of Wayne county.

Though quite hilly, Wayne county has but little of the mountain character. It is not so well adapted to agriculture as to grazing interests. Near Carley Brook, just below Upper Lake Wilcox, there is a strip one and one-half miles long which contains some very fine hemlock, probably 300 acres. Some of it would scale 20,000 feet to the acre. From Rileyville to Mount Pleasant up and down the valley, there is a fairly dense hardwood growth. There is no pine, nor are there any signs that it ever was so abundant here as in Pike county. Sugar maple is the dominant wood, and some of the trees are four feet across the stump. Most of the hardwood is half grown, and the wood acid factories will make heavy inroads on these forests before they mature. The mills, it is said, are sawing more bass wood than anything else.

So far as Wayne county is concerned, there is no reservation possible in it. On the area between Equinunk, Como and Stockport, the timber for the most part is young maple, beech and birch. Two properties containing about 300 acres have a good showing of matured hemlock, probably averaging from 10,000 to 12,000 feet to the acre, and bark averaging a cord to 1,500 feet.

It seems proper to state that the tendency in this county is to an increase in the quantity of timber. It is being reproduced faster than it is cut. The acid factories, which threaten to destroy most of the wood, show no tendency to increase their output. The annual consumption of hard wood for wood acid is about 17,000 cords. For tanning purposes 80,000 feet. A mill at Lake Como ships 200,000 feet B. M. of hard wood lumber out of the county annually. Another at Como Station has for several years past shipped from 100,000 to 200,000 feet B. M. hard wood lumber. But is almost done in that region now.

The tendency to natural reproduction of hemlock in the shady parts of Buckingham township is unusual. Only rarely does one see

a white pine approaching maturity. In fact, Wayne county never did have much timber of this kind. The highest peaks are covered with woodland, also the steeper part of the valleys, near the streams. The midlands are mostly cleared. The chief function of this county should be dairying and stock raising.

It is strange to see in Wayne county that wood is almost the sole fuel used by the farmers, notwithstanding the proximity of the coal fields.

It should be added here that the assessors report only 9.2 per cent. of Wayne county in timber. This is misleading. They evidently mean to include only pine and hemlock. The hard woods, however, should be included, which will bring the area of timber up to not less than thirty per cent.

***Westmoreland county:**

Entire acreage estimated by geological survey,	665,600
Entire acreage estimated by assessors,	568,973
Acres in cleared land,	420,877
Acres in timber land,	148,096
Proportion of timber land to whole (per cent.),	26

"Trees that grow best are white oak, black oak, chestnut, hickory, black walnut, locust, ash, poplar and maple.

"Any limestone and sandy soil will do for oak, walnut and locust."

Remarks:

Though the Forestry Commission was unable in the time allowed, prior to reporting, to visit and to make anything like a full report upon the forest conditions of Westmoreland county, yet it should be said that some satisfactory information was gained by a brief visit. There still remains a considerable body of fine hemlock on the western slope of Laurel Hill. It extends up well into the mountain gorges. Much of it is now over-ripe and deteriorating. Nothing more plainly indicated the scarcity of white pine in the region than the fact that the shingles used were almost entirely of oak. Indeed, the age of some of the shingles might indicate that there never had been much white pine in that district. Lin and cucumber trees were quite frequent in the higher, damp mountain gorges. Red oak and locust of good size and quality appeared in suitable locations. Crossing Laurel Hill from Ligonier to Jenner (in Somerset), black and yellow birch will be found on the mountain sides.

Wyoming county:

Entire acreage estimated by geological survey,	256,000
Entire acreage estimated by assessors,	179,088
Acres in cleared land,	104,451
Acres in timber land,	74,637
Proportion of timber land to whole (per cent.),	41.6

"Trees that grow best are, oak, hickory, chestnut, hemlock, beech and maple, birch, red spruce."

Remarks:

In the northwestern part of the county near Skinner's Eddy lumbermen cut the two-thirds grown hemlock and peel the bark. There is almost no oak here, and except on steep hillsides no waste ground is visible. Forty per cent. of the ground is in timber, one-half of which is sugar maple. At Skinner's Eddy, the surface of the ridge is well sprinkled with chestnut intermixed with white pine and hemlock.

At Jenningsville large stacks of bark showed the tanning industry was still alive there. The top of "Huckleberry mountain" was burned over after the lumbering operations and is practically bare where we crossed to Bowman's Creek.

In a deep, narrow ravine leading down Bowman's Creek, hemlock, yellow birch and maple grow abundantly and to a large size. There is also some black birch, beech and basswood. On the southern side of the ravine there are at least 6,500,000 feet of lumber which is being cut off by two active mills. South from Bowman's Creek to the county line, the county is without much valuable timber. On forty per cent. of the ground possibly 2,000 feet per acre of chestnut and oak, with some maple, pine and hemlock, are growing. "Huckleberry mountain," which is a spur of North mountain, is worthless for any product other than timber. Part of the country between Harvey's Lake, in Luzerne county, west to North mountain, a spur of the Alleghenies, is still covered with original forest, producing hemlock 10,000 to 20,000 feet per acre, with yellow and cherry birch, sugar maple and basswood. After the hemlock, the yellow birch is most abundant. In the high swamps of this county red spruce is common and very luxuriant, some of it is three feet through at the base. On the top of North mountain beech is very common, probably the most important tree after hemlock. The mills actively at work in all this region mean that but a brief period will be required to strip the country.

Extensive conflagrations have been at work along the railroad leading to Ricketts and for miles the country is black with standing timber killed and with ruined tree trunks. Following the Mehoopany

from Bella Sylva to Forkston, we find chestnut, butternut and walnut. Butternut is common. On the mountain tops there are bodies of red spruce, most of it is dead or dying. Near Ricketts there are some signs of the Peridermium on the spruce.

The region between the north and south forks of the Mehoopany, (which meet at Forkston), is still mainly wooded, although much of the best is gone. From Forkston north to the river slope and then west the country is hilly, but cleared. There is some white pine and hemlock still on the higher ground. Hickory, shell-bark and black and white walnut are found along the river though not abundantly. Sugar maple is found on the ground (where it is allowed to remain) if not crowded out by other trees. Ash and basswood are fairly common.

York county:

Entire acreage estimated by geological survey.	588,800
Entire acreage estimated by assessors.	532,504
Acres in cleared land.	437,685
Acres in timber land,	94,819
Proportion of timber land to whole (per cent.).	17.8

"Trees that grow best are, white oak, rock oak, chestnut, hickory, black walnut and locust.

"Soil best adapted is limestone and clay for oaks, hickory and walnut; sandy and slate for locust, chestnut and pine."

Remarks:

In the ravines which come down to the Susquehanna river from the table land to the southwest there is still a considerable body of well grown timber; but as a rule it is safe to say that in this county, where land is fertile and valuable, only the rougher, steeper and poorer portions are covered with timber, the rest is mainly and properly devoted to agriculture. It is remarkable how many species of trees are naturally, more or less common, in this wealthy and beautiful county; which in size and resources is almost a Commonwealth in itself.

CHAPTER XIV.

PARTIAL STATEMENT OF PRODUCTION AND USE OF
LUMBER.

AMOUNT OF TIMBER RAFTED FROM 1875 TO 1895 TO WILLIAMSPORT EXCLUSIVE OF THAT CARRIED BY RAILROAD.

	Pine and Hardwoods (feet).	Hemlock (feet).	Total (feet).
1875,	190,783,220	19,963,736	210,746,956
1876,	114,775,647	19,620,646	134,396,293
1877,	99,691,549	7,252,708	106,944,257
1878,	102,429,306	9,629,658	112,058,964
1879,	171,465,320	19,083,791	190,549,111
1880,	115,734,838	17,843,179	133,078,017
1881,	227,484,789	66,863,775	294,338,564
1882,	163,844,243	56,292,158	220,136,401
1883,	203,318,981	100,447,623	303,766,554
1884,	154,467,317	84,890,514	239,357,831
1885,	123,941,583	101,405,972	225,347,555
1886,	79,188,102	74,953,632	154,141,734
1887,	97,584,201	120,495,543	218,079,744
1888,	119,359,059	166,252,230	285,611,289
1889,	35,639,826	68,181,784	104,121,610
1890,	73,158,957	139,009,514	212,168,471
1891,	57,285,471	204,785,923	262,071,394
1892,	27,181,057	155,603,638	182,784,695
1893,	33,197,267	186,984,478	220,181,745
1894,	8,928,204	30,739,404	39,667,608
Total,	2,199,758,887	1,649,789,906	3,849,548,793

Number of logs for above table, 23,850,617.

PRINCIPAL POINTS AND RAILROADS IN THE STATE OF
PENNSYLVANIA PRODUCING AND CARRYING LUMBER.

(Approximate Statement in Fee, B. M., for 1894.)

Williamsport,	225,000,000
From Loyalsock Creek region (exclusive of Williamsport and North Branch),	40,000,000
Buffalo and Susquehanna railroad (Goodyear's road),	100,000,000

Low Grade railroad,	100,000,000
Philadelphia and Erie railroad above Lock Haven, ..	300,000,000
Northern Central railway above Williamsport,	25,000,000
Main line of the Pennsylvania railroad,	50,000,000
Tyrone and Clearfield branch,	50 or 75,000,000
Bell's Gap railroad,	30,000,000
Main Line of the Allegheny railroad,	50,000,000
Western New York and Pennsylvania railroad,	100,000,000
Buffalo, Rochester and Pittsburg railroad,	200,000,000
Pittsburg and Western railroad from Pittsburg to Kane,	50,000,000
New York, Lake Erie and Western,	100,000,000
Bradford, Bordell and Kinzua railroad,	40,000,000
Pine Creek Railroad Company,	50,000,000
Lewistown and Tyrone Branch.	
Williamsport and North Branch,	20,000,000
Coudersport and Port Allegheny railroad,	20,000,000

EXPENDITURE OF LUMBER AS MINE PROPS.

CIRCULAR SENT ASKING FOR INFORMATION.

Dear Sir: In order to ascertain the quantity of timber consumed annually by the most important industries of the Commonwealth, the Forestry Commission has been obliged to ask the co-operation of its friends.

Would you kindly answer the following questions for us at as early an hour as you conveniently can. We of course pledge ourselves that no use will be made of the information which will in any way interfere with your business interests. We shall simply report the entire number of props used in the State, without intimating the number used by any single operator or firm, unless you desire that we should do so—nor will we mention the source of supply.

1. How many mine props do you use each year?
2. How long does an average prop last?
3. What kind of wood do you use?
4. Where do the props come from?

Yours truly,

J. T. ROTHROCK,
Forestry Commissioner.

MINE PROPS.

In order to ascertain as far as possible, the facts connected with the annual consumption of timber in the mining regions of this Commonwealth, the Forestry Commission sent out 630 circulars, of which the foregoing is a copy, to as many coal mine operators.

Two hundred and sixty-five replies were received, from which the following information is derived:

Six million three hundred and two thousand mine props each averaging 6x6x6 inches are used annually equal to (solid feet)	9,453,000
Twenty-three million and ninety thousand lineal feet of prop timber, each averaging 6 inches in diameter (solid feet),	5,772,583
Two hundred and twenty thousand caps three-eighth cubic foot each, allowing each to average 18 inches square by 2 inches thick (solid feet),	82,500
Six thousand one hundred tons (2,240 pounds) of prop timber averaging 32.1 pounds to the cubic foot (32.1 pound weight of pitch pine) (solid feet),	426,292
Allow for various other purposes,	236,179
	15,970,554

As this number of cubic feet is supposed to be about one-third of the prop timber used by all the mines, three times this amount will represent the entire yearly consumption, or 47,911,662 solid feet.

Ninety million six hundred and one thousand four hundred and sixty-one tons of coal were reported mined in Pennsylvania in 1893. It is estimated one prop is used for every three tons of coal mined, consequently 30,200,487 props would be required in that year, equal to 45,300,730 cubic feet.

By the first calculation 47,911,662 cubic feet, and by the second 45,300,730 were used. If we take one-half the sum of these results, we shall have approximately the correct amount of mine prop lumber used annually, or 46,606,196 cubic feet equal to 559,274,352 feet B. M.

Assuming that 4,000 feet B. M. of lumber (which is a liberal estimate) to be grown on one acre, it would require 139,818 acres of land to furnish the amount of prop timber necessary for one year's supply of the coal mines in our State. This is about 218 square miles.

TIMBER USED BY RAILROADS.

CIRCULAR SENT TO RAILROAD COMPANIES OPERATING WITHIN THE LIMITS OF THIS STATE.

Dear Sir: Enclosed herewith is a copy of an act of the Legislature, approved the 23d day of May, 1893, by virtue of which the Pennsylvania Forestry Commission is conducting its investigations.

A most important element in the work before the Commission is to ascertain as nearly as possible, how much of the timber which each leading business interest of the State consumes, has been produced within the limits of the Commonwealth.

Will you be kind enough to furnish this office with answers to the following questions, if it can be done without undue labor on your part?

The Commission will be most thankful for any aid rendered it and it will be duly acknowledged. Blanks similar to the one attached will be furnished on request.

Yours truly,

J. T. ROTHROCK,
WM. F. SHUNK,
Commissioners.

How many new railroad ties are used annually and, if possible, please state what the number is of white oak, rock oak, black oak and chestnut respectively?

What is the average duration of a first class white oak tie?

How many feet (specify whether cubic or board measure) of lumber do you use in general construction each year exclusive of bridge building?

How many cords of wood do you use for fuel?

How many feet (cubic or board measure) do you use in bridge building annually, exclusive of general construction?

Do not include in your estimate any timber produced outside of the State.

One hundred and eight circulars of which the foregoing is a copy, were sent by the Pennsylvania Forestry Commission to the several railroads acting as common carriers in this State.

From the seventy answers received the following figures are derived: 3,129,417 ties are used yearly by the roads represented. The mileage covered by the railroad companies not reporting is 1,212, and estimating that 352 ties to the mile are used, we have in addition to the former number 426,624 ties or 3,556,041 ties for the an-

nual consumption. Estimating a tie to contain forty-four feet, seven inches B. M. the number of ties used would equal 158,540,160 feet. B. M.

The average duration of a first class white oak tie is seven years. Of the other woods a much less time. The number of ties of each kind reported is as follows:

Of white oak,	1,150,513
Of chestnut,	555,470
Of hemlock,	102,500
Of rock oak,	127,737
Of black oak,	128,043
Of other kinds,	1,531,855

3,556,118

Summary.

158,540,160 feet B. M. used for ties.

17,990,504 feet B. M. used for general construction.

8,246,189 feet B. M. used for bridge building.

78,240,768 feet B. M. or 61,126 cords of wood used as fuel.

263,017,621 feet B. M. used annually by the railroads.

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